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Building Wooden Ships for the Emergency Fleet Corporation

By E. A. SUVERKROP
Associate Editor *American Machinist*

We are all familiar with the formation and functions of the Emergency Fleet Corporation, but few of us who have not seen what this organization has accomplished can appreciate the gigantic work that has been done by it and the firms directly under its control to defeat the U-boat and satisfy the call that went out from the Allies of Europe for "Ships and still more ships."

A LITTLE over a year ago Hog Island was a mosquito-infested swamp; today it is a thriving industrial community employing over 30,000 men. A year ago forest trees and jungle covered the site of the Traylor plant at Cornwells on the Delaware; today there are 10 ways for wooden ships, several ships have been launched and are now fitted out, while others are in various stages of construction. What has been done in these two yards is practically a duplication of what has been done in over two hundred others, with the result that about a half million tons of ships were launched on the Fourth of July. The entire Traylor plant covers an area of about ninety acres, about thirty of which are taken up by the yard proper. In June last year this tract of land was covered with heavy timber and underbrush.

The first job was to clear the ground and build the ways. This, together with the laying of the first keel, was completed by September, 1917, when because of lack of timber and the advance of cold weather work was discontinued till March, 1918. With the arrival of timber at that time work was resumed; the first 3500-ton cargo ship was launched on the first of June and the second on the Fourth of July. Other ships will follow at short intervals. Originally 10 ways were provided for, but owing to a change in orders five only were completed. Now, however, it has been decided to complete the other five so that the output of ships can be expedited.

The cargo carriers being built at the Traylor plant were designed by Mr. Ferris, formerly chief designer of the Emergency Fleet Corporation. They are "standardized," that is to say they are all as nearly duplicates of one another as it is possible to make them. Their chief dimensions are: Length, 281 ft. 6 in.; breadth, 46 ft.; depth, 26 ft. The amount of timber necessary to build one ship is 1,600,000 board ft., of which about 30 per cent. goes to waste. The various members are fastened together with spikes, bolts, rivets and treenails (these latter outside a shipyard would be called wooden dowels). For the construction of one ship 132 tons of bolts, rivets and spikes are required. These vary in size from $\frac{1}{2}$ in. square for the spikes to $1\frac{1}{4}$ in. round for the bolts and rivets, and in length from 6 in. to 6 ft. Of treenails 52,000 are required for each ship. These are made of selected straight-grained locust. In diameter they are about the same as the regulation locust club used by policemen and watchmen.

Each ship is driven by a single screw actuated by a 1400-hp., triple expansion, reciprocating steam engine. Steam for the engine is obtained from two single-end water-tube boilers of the marine type. For handling

cargo two spars, or masts, are provided, one forward to serve the fore hold and one aft to serve the after hold. The masts are respectively 96 and 83 ft. long. Around them cargo booms are arranged on goosenecks, and each boom is served by a steam winch. Four of these winches are bolted to coamings in the corners of the rectangular well that surrounds each of the cargo masts.

Before taking up the actual building of ships a short description of the social conditions in the yard might be of interest.

The welfare and industrial relations are under the direction of an experienced man trained in that best of diplomatic schools—a first-class hotel. All the important grievances and many of the minor ones come up before him for settlement.

The village of Cornwells is about two miles from the yard, a little too far removed for the average man who wants to live near his work. Appreciating this the company erected a number of tent-like structures, which are located in a beautiful wood where the children of the men can have the "time of their lives." Provision has been made so that these buildings can be boarded up on the sides and roof, thus making them habitable when the weather becomes cool. While these houses are for the use of the artisans, the head of the industrial-relations division occupied one of them with his wife all last summer.

In another location a number of small frame-and-cement houses have been built for the officials, foremen, etc. These, while very substantial and attractive, rent for a very moderate sum.

Between these camps and the yard is the commissary, where all sorts of household supplies can be bought at reasonable prices.

Next door to the commissary is a motion-picture theater where good films are shown or concerts given every night, a fine orchestra and choir having been organized from among the men in the yard.

At the restaurant a really first-class meal can be bought for what it costs the company.

The labor bureau is also located in this clump of buildings. Here the applicants for work are interviewed by an experienced labor man. Skill in any of the branches of wooden shipbuilding or in the use of any of the tools used in wooden shipbuilding is of course desirable but not at all essential. With good health and a moderate amount of strength and gumption valuable specialists can be rapidly trained by those in charge.

Candidates for work, after having passed the oral examination given them by the labor man, are turned over to the doctor, who examines them for hernia and tests their heart, lungs and sight. With a clean bill of health from the doctor they are distributed among the various departments, the skilled men to the work for which they are fitted and the unskilled or partly skilled to those departments where it is expected that they can most readily be adapted to needs.

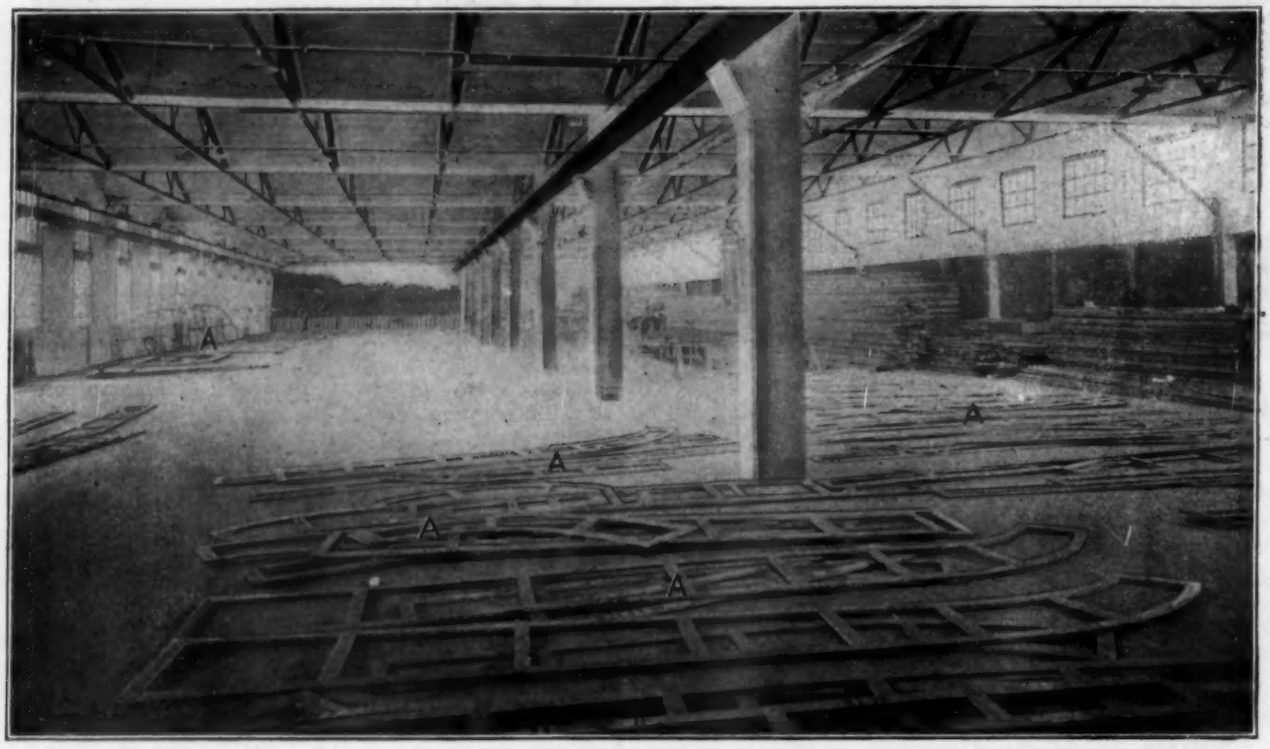


FIG. 1. THE MOLD LOFT

The experts of the Emergency Fleet Corporation have reduced the art of shipbuilding to its simplest terms. The men in charge of departments are all highly skilled and familiar with every phase of the work over which they are placed. There are among the men a number of practical shipbuilders, but by far the great majority are not shipbuilders and there is no necessity that they should be. As previously stated, health and a moderate amount of strength and common sense are the chief requisites. If to these is added the ability to acquire the use of tools, then a man having such ability and meaning business cannot help but become skilled in the small but necessary work required of him to fabricate the ship.

As a matter of fact under the conditions existing at the Emergency Fleet Corporation's yards, the building of a 3500-ton ship is as easy as or easier than the advertisements in the yachting papers would have us believe it is to build a rowboat from paper patterns. Paper patterns are very unstable thing, and the man who builds a boat by this method usually has to rely on his interpretation of the written description or on the advice of well-meaning friends who often know less than he does. Besides this he has to do all the work from the laying of the keel to the finishing of the cabin, if there is one. On the work under discussion the conditions are entirely different. There are experts who are familiar with each step in the building of the ship and the installing of the engines. They are there to watch things and to see that as few mistakes as possible are made. They are there to answer questions correctly and and when the unforeseen happens to determine what shall be done. All of which, out of the wealth of their experience, is a simple matter for them to do. They instruct the green men who have never worked at shipbuilding; they see that those who show special aptitude are advanced, and they also see that they are not advanced beyond their class, for ships and not experiments are the desired product.

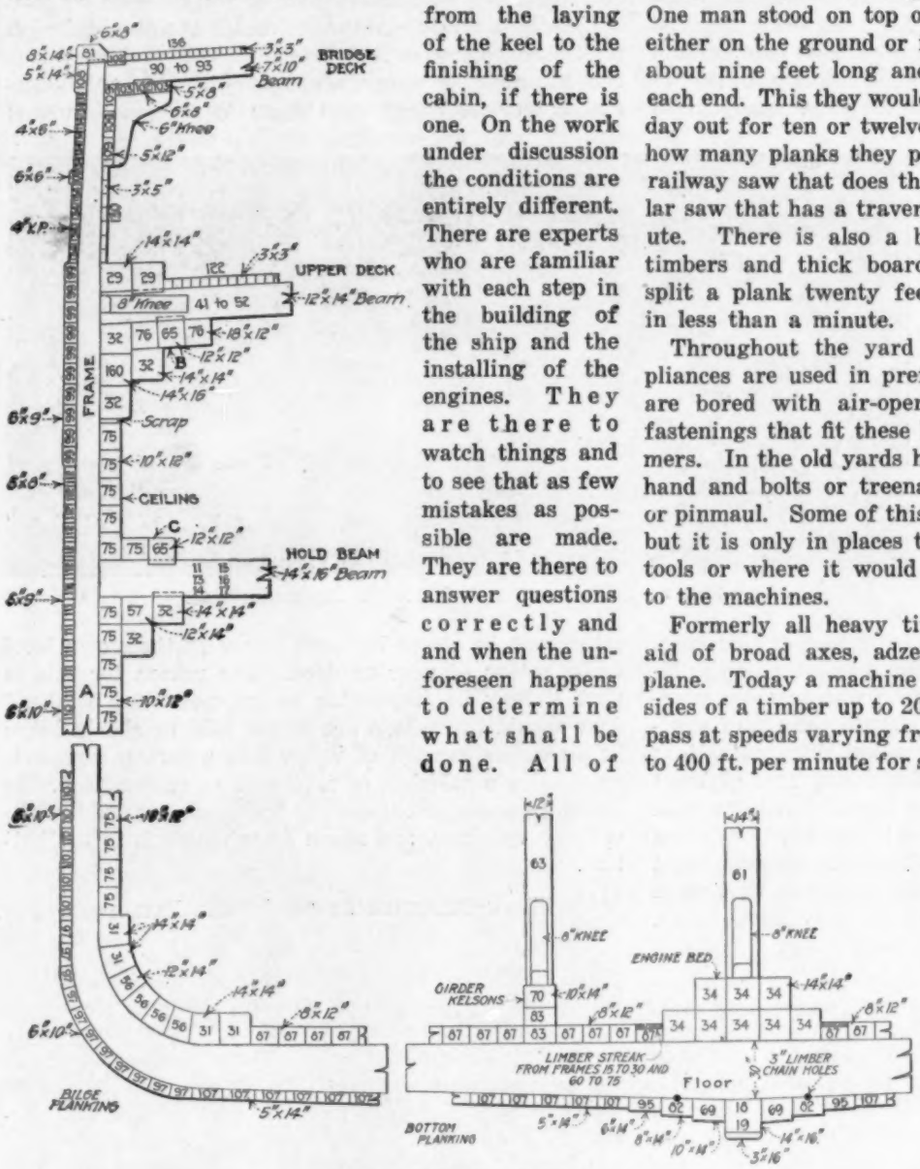


FIG. 2. TIMBER ITEMS

So in this way green hands are taught to be skilled specialists in one or more of the hundred-and-one branches of shipbuilding, and it has been frequently found that many of the men thus developed turn out more and better work than do some of the old-time ship carpenters. The trouble with many of the latter is that they are apt to be "sot" in *their* ways, and their ways, because times and methods have changed, are not always the correct ways.

In the old-time shipyards there were practically no power-driven appliances beyond perhaps a circular saw, and even these were not common. I can well remember two men with a big "pit saw" sawing a squared log into planks. One end of the log was raised with a block and fall at an angle and rested on a big trestle. One man stood on top of the log while the other was either on the ground or in a shallow pit. The saw was about nine feet long and had a round cross-handle at each end. This they would pump up and down day in and day out for ten or twelve hours a day. I have no idea how many planks they produced; but in this yard is a railway saw that does the same work, but with a circular saw that has a traverse of about twenty feet a minute. There is also a band resaw for sawing heavy timbers and thick boards into thinner ones. It will split a plank twenty feet long into two thinner ones in less than a minute.

Throughout the yard wherever possible power appliances are used in prefence to hand tools. All holes are bored with air-operated drilling machines. The fastenings that fit these holes are driven with air hammers. In the old yards holes were laboriously bored by hand and bolts or treenails were driven with a beetle or pinmaul. Some of this work is still done in this way, but it is only in places that are inaccessible to the air tools or where it would cost more to carry the work to the machines.

Formerly all heavy timbers were squared with the aid of broad axes, adzes and finished with the hand plane. Today a machine called a "sticker" dresses four sides of a timber up to 20 x 30 in. and any length at one pass at speeds varying from 120 ft. per minute for large to 400 ft. per minute for small timber. This machine has four knives similar to those used in the ordinary wood planer used in the pattern shop. Two of them are vertical and adjustable to and from each other; two of them are horizontal and also adjustable to accommodate various thicknesses of timber. Power for the machine is delivered by a 100-hp. motor. The quality of the work of this machine is superior to that turned out by hand tools and very little skill is required to operate the machine. Formerly all dressing of timbers, both square and beveled, was done with the hand tools described in a preceding paragraph. A new machine has recently been developed for this work. This machine is called a beveling machine and handles all square and beveled work many times faster than the most expert broad-axe man could. When working on beveled work the angle is accurately cut and the finish is superior to hand work.

Instead of the old-time clumsy hand cranes used when I was a boy the yard and shipways are served by special traveling cranes designed and built by the Traylor Engineering Co., Allentown, Penn.

All these appliances use a large amount of power, but if we will remember that it takes from 10 to 20 men to equal one horsepower and that man or animal power can only be successfully worked for eight hours a day while steam, electric or air power can work for 24 hours a day without fatigue, we then have an idea of what would have been required in the way of men under the older conditions to complete a similar amount of work in a similar time. Take, for instance, the item of squaring large timber, and considering it in terms of horsepower for 8 hours a day only. The 20 x 30 sticker uses 100 hp., which would mean a force of about 1000 to 2000 men on this job alone. If we were to consider the other labor-saving machines in a similar manner we would find that they represent a man power many times greater than the entire force employed in all departments.

The operatives who are assigned to work on the various ships are under the direct supervision of a so-called captain, who has charge of each of the ships under construction and who is responsible for the quality and quantity of work turned out by his men. I may mention that so far as I have been able to find in this yard there is only one unpardonable sin; that is, soldiering on the job, being caught at which means instant dismissal; and I may also mention that soldiering is not at all common at this time.

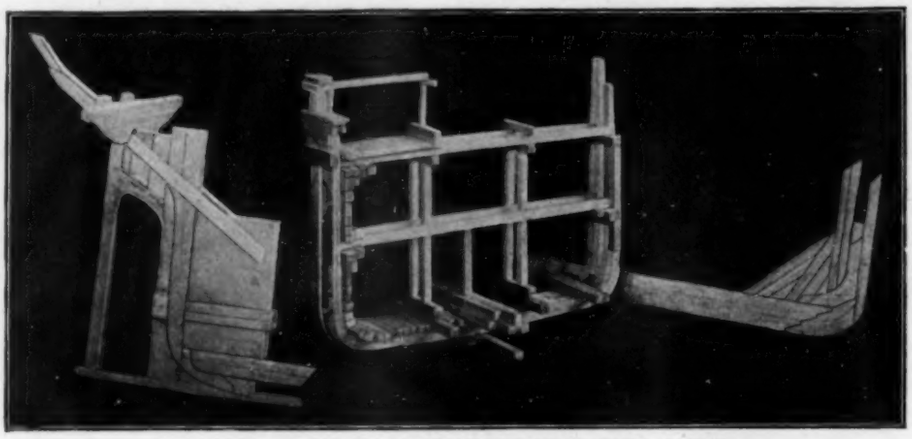


FIG. 2. SCALE MODELS SHOWING TIMBER ITEMS

The captains may or not be familiar with shipbuilding. One of them is a young man who recently graduated from a college, where he learned the art of steelship construction; another was a building contractor; others have followed other callings, but most of them have had charge of men. They must be able to read blueprints and must not be afraid to ask questions when necessary. It seems to me that their greatest asset must be a knowledge of their men's limitations so that when material holdups occur at one point they know which men will be able to tackle some other part for which there is plenty of timber.

Houses and Ships Similar in Construction

There is considerable similarity between a frame house and a ship. In the house the skeleton has ribs, and although they are usually straight their function is the same as the ribs of a ship; that is to say, the outside planking is secured to them. A house has floors and so has a ship, but they are termed "decks." Floors are secured to joists; so are decks, but we do not call them joists, but "deck beams," and the principal difference is that the deck beams are much heavier. Houses have internal walls; so has a ship, but we call them "bulkheads." They are much more substantial than the walls of any frame house, and they not only divide the ship into what in a house would be called rooms but they also help to strength the entire structure of the ship. Bulkheads that run crosswise are called "thwartship" bulkheads, and those that run lengthwise are called longitudinal or "fore and aft" bulkheads.

There are stairways leading from one deck to another, in nautical terms called "companion ways" or "companion ladders," but they serve the same purpose as the stairways in a house.

The space for cargo at the bottom of the ship is called the "hold," while the cargo space on the various decks below the upper deck is termed the "'tween decks." The openings in the decks through which the cargo is lowered and raised are called "hatchways" and the lids for these are called "hatch covers."

Watertight Doors

Usually in steel ships the bulkheads are provided with watertight doors at the levels of the various decks. Sometimes these doors are provided with automatic-closing devices which close them in case of accident; others can be closed by hand either at their own level or by means of gear on deck. The reason for this is that it may be impossible to get near the bulkhead door should there be a fire in the hold or should there be an excessive rush of water into a certain compartment after a collision, or a torpedo or mine attack. In the ships under discussion the bulkheads are solid, without any openings, and reach from the deck to the bottom.

Work Preliminary to Actual Building

The naval architect's drawings give the ship's "lines," which show the shape of the ship at various vertical and horizontal planes passing entirely through her. In other words, they show the shapes of a series of sections of the completed ship. These sections, or cuts, having been made entirely through the ship at specific intervals both vertically from the keel upward and parallel to it, and horizontally from bow to stern also parallel to the keel and vertically from side to side and at right angles to the keel. The measurements are taken from these lines and set down in what is called a table of offsets.

With this table of offsets the layer-out goes to the mold loft, Fig. 1 (they are always called mold "lofts," although like this one they may be on the ground floor), and lays out the lines of the ship full size on the floor. From these lines on the floor he then proceeds to lay out the molds *A* shown lying on the floor in Fig. 1. These are light patterns, or templets as the machinist would call them. They are made of seasoned white pine $\frac{3}{8}$ or $\frac{1}{2}$ in. thick. It will be observed that they are not solid but built up. This is for the sake of lightness, so that

they can be handled easily, and also in order to render them less liable to breakage.

These ships are, as previously stated, standardized, and a mold made for one part of one ship can be used for the same part of all the other ships of the same size.

From the designer's drawings and bills of material, the rough timbers for the various parts are ordered from the lumber camps. Because a mold happens to be made to the dimensions of the whole of a single part does not of necessity mean that the part itself must be made of a single piece of timber. In fact there are many places where for the sake of strength alone it is desirable to make a part of two or more pieces of timber. There are also pieces that could be made from a single piece were it not for the fact that timber of such large dimensions cannot be obtained.

In the original plans the designer identified each different piece by a number, in this way greatly facilitating the work of men who were not familiar with ship-

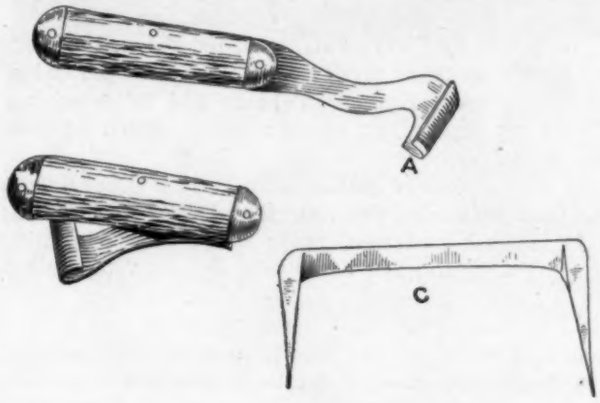


FIG. 4. RACE KNIFE OPEN AND CLOSED AND SHIP CARPENTER'S DOG

building. Thus every piece of a certain breadth and width has a distinguishing number. My meaning will be more apparent if the reader will look at Fig. 2, which are details giving the timber items for practically the whole hull. Fig. 2 is a part section amidships showing the deck and hold beams and their supports, one of the frames at *A*, the planking on the outside and the ceiling on the inside. As both sides of the ship are the same at any given point throughout the length of the keel, this drawing practically tells the whole story of timber dimensions and construction.

However, to further simplify the work to those who could not grasp the significance of the lines in these blueprints, Mr. Davis, the naval architect at the yard, made small-scale models, as shown in Fig 3, and placed these where they would be accessible to anyone who wished to see the timbers as they would actually be in the completed ship. In these models each timber is plainly marked in ink with its designating number, so that by noting this and referring to the blueprint, Fig. 2, one can readily get the dimensions for timbers for any specific part and their location. Take, for instance, the planking on the outside of the ship. It will be noticed that these pieces vary in thickness, depending on their position on the frame. Thus between the upper deck and the bridge deck in Fig. 2 they are designated by the number 134 with the exception of a single strake marked 106. The pieces marked 134 are all 4 x 6 in. So wherever throughout the construction of the ship the drawing calls for 134 we know that timber 4 x 6 in. cross-section is required. In the same way 106 calls for 6 x 6 in. timber. By referring to the location on Fig. 2 where the reference letters *B* and *C* occur, one can see how these numerical distinguishing marks are used for the same size of timber, but in entirely different parts. At *B* the timber 65 forms part of the stringer (bracket) for the support of the upper-deck beam; at *C* it forms a part of the so-called waterway, or stringer, on top of the hold beam, but in both cases it is 12 x 12 in. cross-section.

The mold loftsman's duty is to mark off the timbers for the ship as they are needed. The marks on the timber are made with what is called a race knife shown in Fig. 4. This tool has a blade that is bent over at an angle and terminates in a small gouge. When drawn along the timber with one side of the blade in contact with the mold, or pattern, the gouge edge at *A* cuts a shallow groove about $\frac{1}{8}$ in. wide by $\frac{1}{32}$ to $\frac{1}{16}$ in. deep on the face of the timber. The mark made in this way is very durable and can be readily seen even after the timber thus marked has been exposed for a considerable time.

The Ways for the Ships

While this work is going on in the mold loft and timber yard other men are preparing the ways where the ship is to be built. Ships are built in two positions with reference to their launching; that is to say, some are launched endwise and some sidewise. Where they are launched sidewise the ways are level from end to end of the ship. This method, however, where many ships are to be built, requires considerable waterfront. Where the ships are launched endwise the ways incline toward the water, the grade being about $\frac{5}{8}$ in. to the foot.

While the following has nothing to do with the building of wooden ships it may be of interest to note here that steel ships are never built pointing north and south, but as near east and west as it is convenient to build them. The reason for this is that a steel or iron ship built north and south becomes a huge permanent magnet, and magnetic compasses mounted on them can never be trusted. The magnetic effect is also intensified in modern shipyards by the vibration of the pneumatic hammers now used in all yards to set the rivets. This same magnetic effect has also been noted as taking place in ships that have had partial breakdowns which have retarded their speed while they were steaming a northerly or southerly course.

Use of the Model

To act as a guide for the builders of the ways Mr. Davis also built a scale model so that they could actually see what they were expected to build.

On solid ground no foundation is necessary; the lower timbers can be bedded down below the top soil and the keel blocks can be "cribbed up" upon these. In soft ground piling is necessary and when driven to a sufficient depth their tops are sawed off to the correct grade which is readily determined with the aid of a transit. The rows of piles are then capped with suitable timbers.

The reason for "cribbing up," that is to say, building up the timbers for the keel blocks in the same manner

that a loghouse is built, is to give greater stability, for if they are merely laid one on top of the other there is a tendency for them to roll over as the weight of the ship increases.

When building up the keel blocks one should remember that the planks next the keel must later be fastened to the frames and there must be room to bore the holes and drive the fastenings. For this reason it is advisable not to make the keel blocks too wide. The tops of the blocks should of course be pitched to the grade angle of the ways so that the keel will lie evenly on them. The weight on the keel blocks will usually hold them securely without any fastening, and sometimes they have none. In some yards they are secured together with dogs, Fig. 4 at *C*, similar to but much larger of course than those used by patternmakers. They may also be doweled together. Whichever way they are fastened together it must be remembered that they will be removed before the ship is launched. For this reason they should be secure while in use but readily removable when the necessity arises. In any case the upper block should be readily removable so that bolts can be inserted and riveted up in the keel and planking and also that the oak wearing strip on the bottom of the keel can be attached. This oak wearing strip is about 3 in. thick and the same width as the keel. It is secured to the keel by two bolts, and, as its name implies, takes the wear which would otherwise fall on the keel when the ship is in graving dock.

How Did He Make This Casting?

BY D. LITTLE COLE

The other Sunday while holding religious exercises in my cellar and speculating upon whether or not I would be able to get through another winter with the scanty supply of fuel left in the bin from last season I discovered that the grate in my boiler was nearly burnt out and would have to be replaced with a new one before I could hope to even practice economy on the coal bin, to say nothing of performing it before an audience. The "main squeeze" of my heating system is a small steam boiler of the vertical tubular type with a two-piece stationary grate, and was built so long ago that the maker's name is lost to history; therefore there arose in my mind fantastic visions of rosewood patterns, war-time patternmakers, and a bill of about $67.92.

However, I simply had to have the grate, and as the old one was so badly burnt as to be useless as a pattern I hied me to Pat Moriarty's, who runs a little foundry and machine shop down near the water front, and by means of many gesticulations and a quantity of "technical" language explained the situation.

"Wheer's yer pathern?" says Pat, who is head molder-machinist-patternmaker-and-bookkeeper.

I confided to him that the boiler had been one of the auxiliary battery in use on the ark and that Noah had personally "busted" up the grate pattern for fuel in a frantic effort to keep steam the day before Ararat was sighted.

"Come on up to the loft, an' we'll find ye a pathern," says Pat, and up we went. After rummaging around for a few minutes in a pile of old patterns that had been thrown in a bin as of no further service, Pat emerged, triumphant and dusty, holding up a single-piece pattern at least twice the diameter of my grate, with a square rim section (mine was rabbeted) and with bars and spaces that might easily have been the grandparents of my grate bars.

"Here's just what ye want," says Pat.

"Heavens, man!" says I, "it's a grate I want; not a cartwheel."

"Lave it to me," says Pat, "we'll jist shtop it off here and here"—he made mysterious passes with the end of his rule—"and thrim up th' baars wid th' trowl, an' it'll be all right; jist ye lave me a sketch of yeer ould grate."

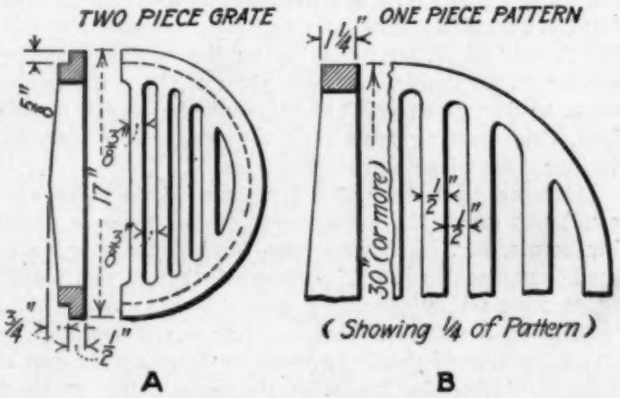
So with a piece of chalk I laboriously laid out upon a flagstone a detailed drawing that looked (some) like *A* in the cut, and went sadly away, never expecting to see Pat again, for how could anyone "stop off" a round pattern to make a smaller round pattern? How could he move grate bars nearer together and make a mold that would cast the bars thinner than the pattern? Two days later came a jingle of the telephone bell:

"When are yez comin' afther the graate?" says Pat's voice.

"Have you got it done?"

"Sure!" says Pat, "Whaddya think we air—the B. R. T.?"

I went and got the grate. It was a two-piece grate, diameter correct, rim-section rabbeted; bars properly spaced, and it cost me four dollars. *B* in the cut shows the pattern it was made from. How did he do it? And if his brand of knowledge is common among patternmakers, why do we make elaborate patterns when a yardstick will apparently answer every purpose?



THE CASTING AND THE PATTERN

The British 6-In. Howitzer

By I. W. CHUBB
Editor European Edition of the *American Machinist*

IV. The Breech Mechanism

In this article operations on many of the smaller or minor parts are described. The final shrinking of the jacket onto the tube is also illustrated and described.

THE breech bush shown in Fig. 81 is received in the form of a bar from which say half a dozen bushes are obtained, the whole being rough bored and turned and the material heat-treated and tested. The required lengths are then parted off.

Operation 1.—Rough turn and bore—In a vertical turning and boring mill the external diameter is machined 0.3 in. above and the internal diameter 0.03 in. below plan size.

Operation 2.—Slot for interruptions—This is done to marked-off lines with the aid of a templet.

Operation 3.—Face to length—A vertical mill is used, leaving 0.03 in. on the rear face for truing with the gun after building.

Operation 4.—Thread externally—The start of the thread is suited to the top center line of the breech bush.

Operation 5.—Thread internally—A jump lathe is used, the position of the start of thread being given on the drawing.

Operation 6.—Cut radial clearances—This work is done in a slotting machine.

Operation 7.—Fit radial clearance, etc., ready to build—When cutting interrupted threads these have to be accurate to gage, as it is important that they should not be thin or the threads will buckle over as the result of proof firing. Further when marking off at the surface table the word "top" is always stamped on the vertical diameter, and this line is carried through the job. It is also advisable at the surface table when marking off the start of thread to mark the two top interrupted threads A and B both on bush and templet in order to avoid subsequent error. The marking-off templets are usually of zinc; in some instances a bulge is punched from the underside, thus preventing the templet lying flat on the job except when the correct face is in contact with it.

The carrier is a bronze casting, shown in Fig. 82, the exterior of which is not machined but is polished by girls.

Operation 1.—Mark off—When lining up the casting on the surface table the inside faces of rough material are worked off in order to keep equal thicknesses of metal. It may be mentioned that all work is subsequently done from adjusted faces and from standard-height gages.

Operation 2.—Bore and face hinge—A horizontal machine is used, facing being to a gage leaving 0.02 in. a side.

Operation 3.—Slot hinge—A disk gage is employed.

Operation 4.—Mill back and end of pintle—The carrier is set by mandrel through the hinge hole, lying on standard parallels; height gages are used to give correct height from table to surface being machined.

Operation 5.—Adjust back and pintle—This is done on a surface table; a pin again is placed through the hinge hole, the height being adjusted from the table by two standard-height gages. All subsequent work on the pintle is gaged from its face.

Operation 6.—Mill stop-face end.

Operation 7.—Adjust end of carrier and hinge—This is done to within 0.01 in. of finished size.

Operation 8.—Turn pintle—A vertical milling machine, Fig. 83, is used. The jig casting has a boss to locate it at the center of the table, and bears two arms machined to take the hinge pin through the carrier. The job is strapped down and the adjusted face of the carrier rests on the jig.

Operation 9.—Bore and recess back of pintle—For the

safety shutter a radial drill is used with a cup jig, which has a boss to center it in the table.

Operation 10.—Adjust hinge to plan size—By fitters, working square to the hinge and gaging from pintle.

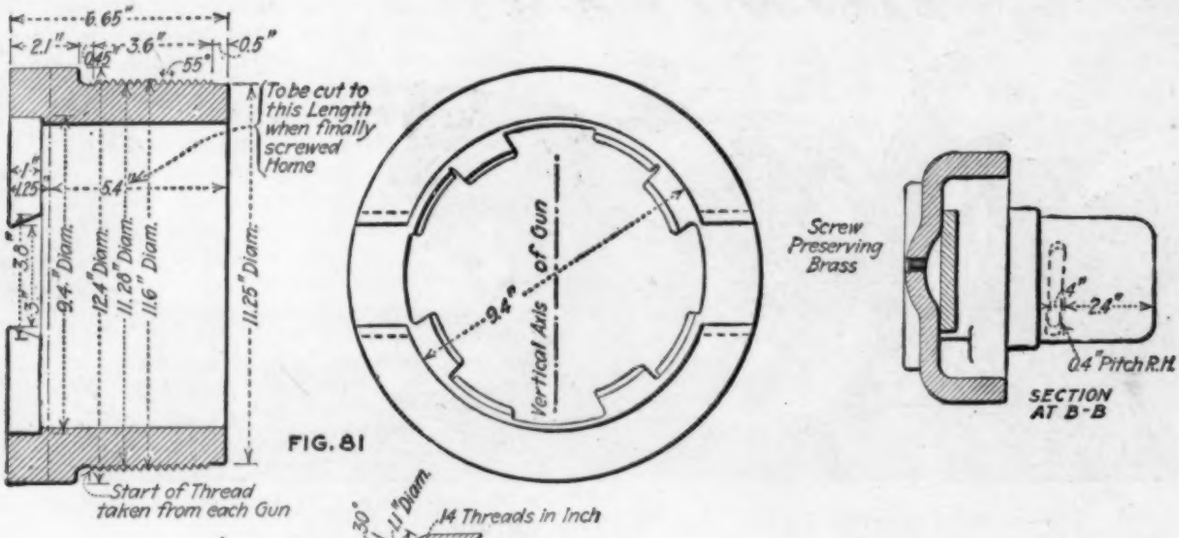


FIG. 81

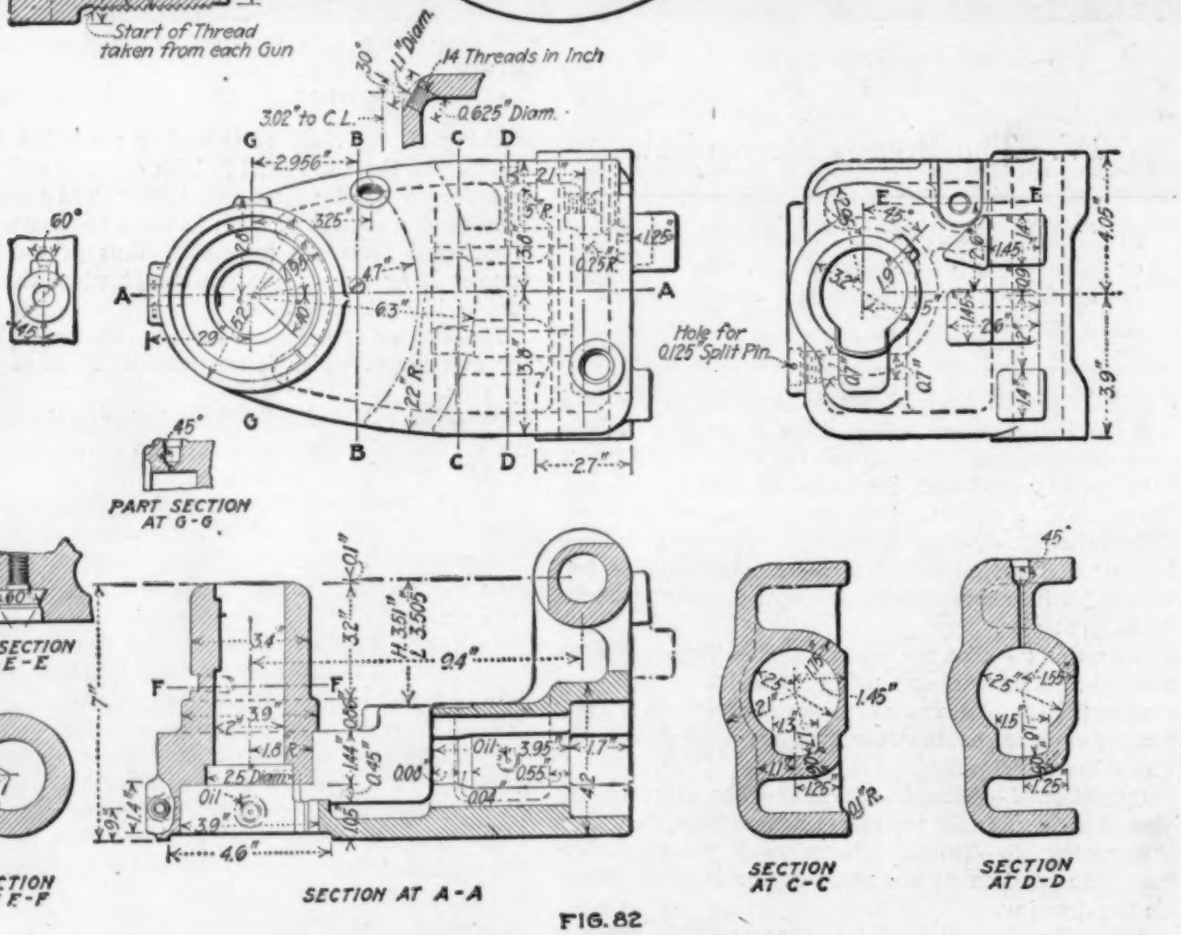


FIG. 82

FIGS. 81 AND 82. DETAILS OF BREECH PARTS
Fig. 81—The breech bushing. Fig. 82—The carrier

Operation 11.—Bore and recess hole for breech-mechanism lever—A box jig, Fig. 84, is used, with a pin through the hinge hole and another through the pintle hole, the height being determined from the pintle face.

Operation 12.—Mill hinge clearance—The circular table of the milling machine is employed.

Operation 13.—Slot key in pintle—The key is for the axial T-vent and is cut from the solid. The projection of the key is determined in the first instance by the size of the hole drilled and in the second place a recess is bored to form a guide for the removal by slotting the material between the recess and the inner bore, leaving the width of material to form a solid key.

Operations 14 and 15.—Mill stop faces—These operations on the stops for the hand lever are important. The work is done from the hinge and face of the pintle on fixtures. The milling is to the scribed marks, leaving 0.02 in. for adjustment by fitters.

Operation 16.—Mill internal clearance for breech screw.

Operation 17.—Mill internal face for bearing, hand lever.

Operation 18.—Shape recesses for projections on bearing, hand lever.

Operation 19.—Drill ends of cannelure on pintle.

Operation 20.—Cut thread groove—This is for the

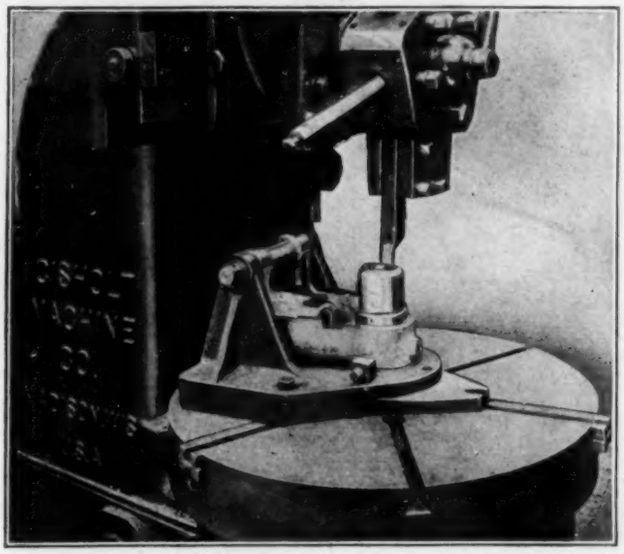


FIG. 83. TURNING THE CARRIER PINTLE

plate-turning breech screw and is formed in the holes previously drilled. The lathe is used and is pulled round by hand, or a kicking device is used, a gage being applied from the adjusted face to the center of the groove. In addition the pocket for the catch plate is milled to scribed marks and oil holes are drilled. The machining allowances mentioned in connection with the breech ring apply here.

The breech screw shown in Fig. 85 is received as a

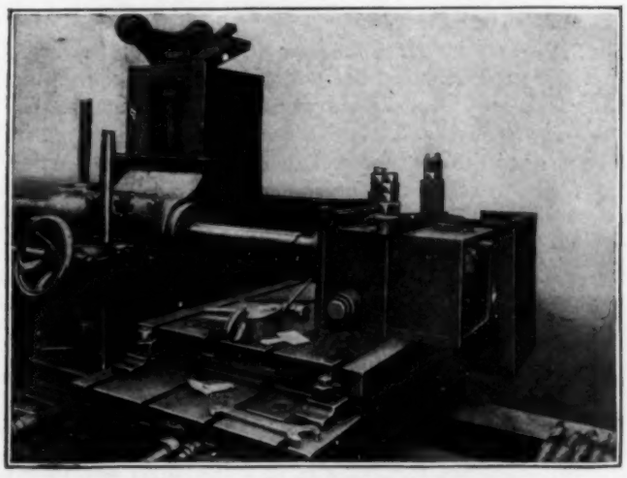


FIG. 84. THE CARRIER BORING JIG

bar of special steel, rough-turned ½ in. above plan size, heat-treated, tested, etc.

Operation 1.—Bore, face and turn front side—For this the top diameter of the thread and flange diameter are turned at one setting in a vertical mill. The face is left 0.008 in. long to enable it to be trued up when cutting the interrupted thread.

Operation 2.—Face rear face and finish-bore—This is a similar operation, the screw being reversed, and the already bored hole being placed on a true spigot.

Operation 3.—Mark off for milling interruptions.

Operation 4.—Mill clearance for slotting interrupted threads—The work is done on a circular table by end mill.

Operation 5.—Fitting—The ends are squared by chipping to allow the tool to get to position when slotting.

Operation 6.—Slot interruptions—The job is held in a boss on the slotter table.

Operation 7.—Drill, slot and fit small clearance—This is for use when jumping the threads; the clearances are cut 0.2 in. deep to enable the chips to get away.

Operation 8.—Mark off profile and form-plane rear

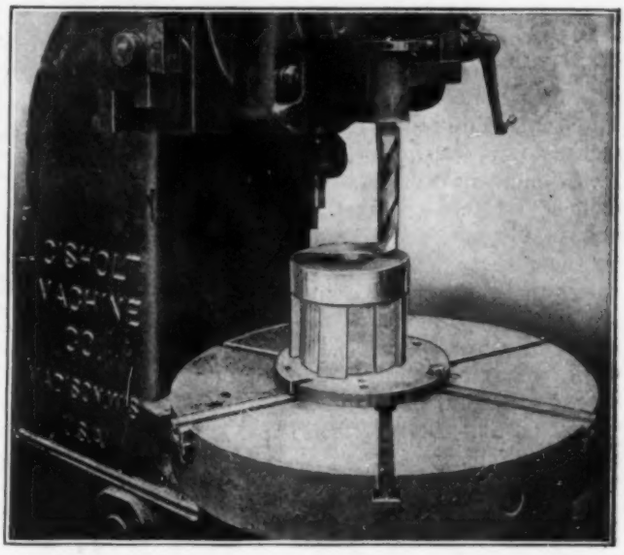


FIG. 86. JIG FOR CROSSHEAD HOLE IN BREECH SCREW

face—For this work the start of the thread positions from the vertical center line.

Operation 9.—Plane rear face—A number of pieces are done in a line on the planing machine at a setting.

Operation 10.—Mark off for shape of crosshead, etc.—A templet is employed.

Operation 11.—Shape profile—This is done round the projections left after planing the rear face.

Operation 12.—Face to length of jump—A boss on the faceplate of the lathe is used.

Threading Operation

Operation 13.—Jump the threads—The start is made to drawing.

Operation 14.—Form spigot on front face—Operations 12 to 14 may be combined.

Operation 15.—Bore crosshead hole—For this the jig, Fig. 86, is spigoted to the table and has an offset boss for the center of the screw.

Operation 16.—Shape crosshead opening.

Operation 17.—Fitters adjust for jig.

Operation 18.—Bore end holes, etc.—They are at each end of the aperture for retaining the plate, also for the axis of the roller pin and the hole for the pin retaining the actuating plate. The jig, Fig. 87, is centralized in the bore of the breech screw and located

by the hole for the crosshead and by the face of the screw. The view also shows the breech screw.

Operation 19.—Mill opening for plate retaining—For this gage from the front face.

Operation 20.—Mill crosshead radii—A vertical mill is employed for this purpose.

Operation 21.—Slot radial clearances—Sheet gages for this are prepared from drawings, reference numbers being employed for application of gages. A casting *A*, Fig. 88, is fixed to the machine and has a hinge to which the casting *B* is pinned. This has a boss locating the breech screw at the gun center from the hinge and keeping the screw in correct relative position from the breech face; also the screw is set to the vertical center line. The connecting-rod *C* is attached to the ram which gives it the slotting motion. The toolbox is placed on the table and is hinged for clearance on the return stroke. It revolves with the table round the screw, having an adjustment for depth of cut. The work, it may be of interest to note, is done by female labor.

Operation 22.—Drill oil holes —Fitting follows.

It is advantageous to leave a few thousandths, say 0.008 in., on the front face of the screw, to be removed when the screw is completely finished, it being very important to have this face free from damage which might occur in course of manufacture.

The tolerances mentioned at the end of the notes on the breech ring apply also to the breech screw, and on the latter no sharp edges or corners may be left.

mushroom head of the axial vent holds the obturator in place against the front face of the breech screw by means of a spring and nut. The bolt, Fig. 89, is of steel received in the form of forged bars long enough for several bolts rough turned about ¼ in. oversize,

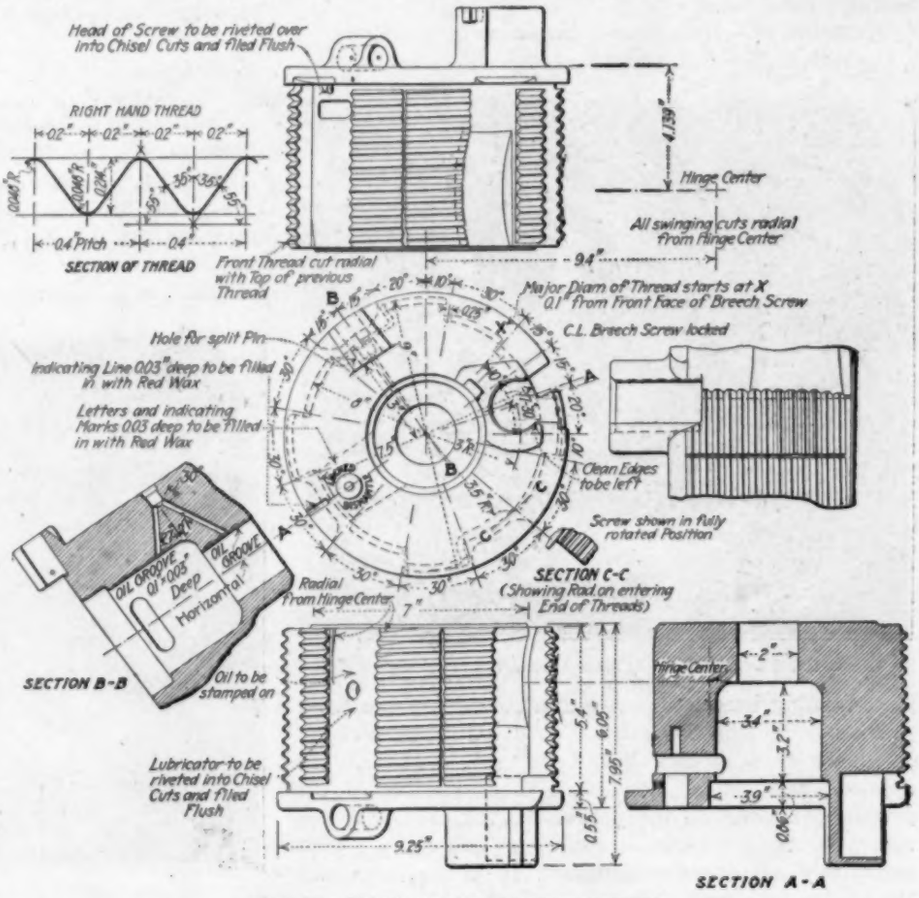

Head of Screw to be riveted over into Chisel Cuts and filled Flush
RIGHT HAND THREAD
.02" .02" .02" .02"
.04" Pitch .04"
SECTION OF THREAD
Front Thread cut radial with Top of previous Thread
1.139"
Hinge Center
All swinging cuts radial from Hinge Center
9.4"
Major Diam of Thread starts at X 0.1" from Front Face of Breech Screw
C.L. Breech Screw locked
Hole for split Pin
Indicating Line 0.03" deep to be filled in with Red Wax
Letters and indicating Marks 0.03 deep to be filled in with Red Wax
Clean Edges to be left
Screw shown in fully rotated Position
SECTION C-C (Showing Rad on entering End of Threads)
OIL GROOVE .01" .005" Deep Horizontal
SECTION B-B
Oil to be stamped on
Radial From Hinge Center
7"
Lubricator to be riveted into Chisel Cuts and filled Flush
9.25"
SECTION A-A

FIG. 85. DETAILS OF BREECH SCREW

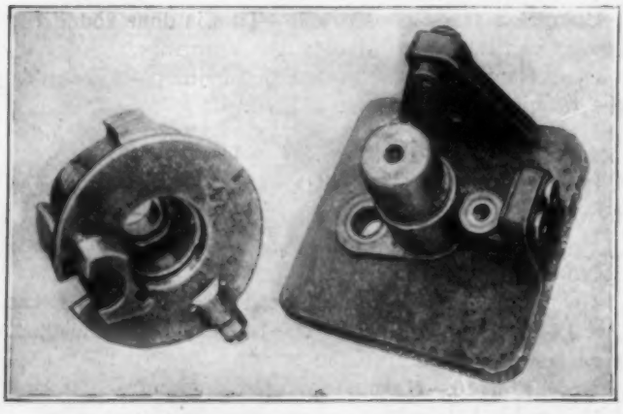


FIG. 87. JIG FOR HOLES IN BREECH SCREW

Through the center of the breech screw and carrier pintle passes a mushroom-headed bolt with a key to prevent turning; it has a long bush chambered and prepared with a bayonet joint for the firing device. The heat-treated and with test pieces taken from each end of the bar. The bolts are afterward parted-off, the two end tests serving for a number of bolts. For the most part the production of the bolt is an ordinary machine job. It is rough-turned and then drilled for the central hole, a twist drill and floating reamer being employed in a vertical drilling machine. Then the exterior is turned and, the threaded end finished, the large end is run in a steady in order to bore out the recess. The limits on the central hole, which is 0.92 in. in diameter, and on the 1.5 in. recess in front, are ±0.0025 inch.

The spindle, Fig. 90, the official title of which is vent bush, is simply rough-turned from the bar and sawed to length, leaving it 1 to 1½ in. long to allow for defects, machining or otherwise, which show themselves when chambering the central hole at the end, the chambering in such case being carried up and the job cut to suit. The central hole is drilled in a horizontal sensitive drilling machine, a twist drill being brazed on the end of a steel wire that is slightly smaller to give clearance. When drilled the work is run on centers and turned concentric with the hole, the shape being roughly blocked out and the collar left 1 to 1½ in. wide. The longer threaded end being finished, the collar is then run in a steadyrest to do the chambering. The taper part is opened out with drills and finished with

form reamers. In the set of plug gages used for checking, one takes the taper clear of the O.G. radius, one has this radius on, one gives the diameter and depth of the recess at the front, and one is an over-all gage.

A sulphur cast is taken of the chamber and carefully

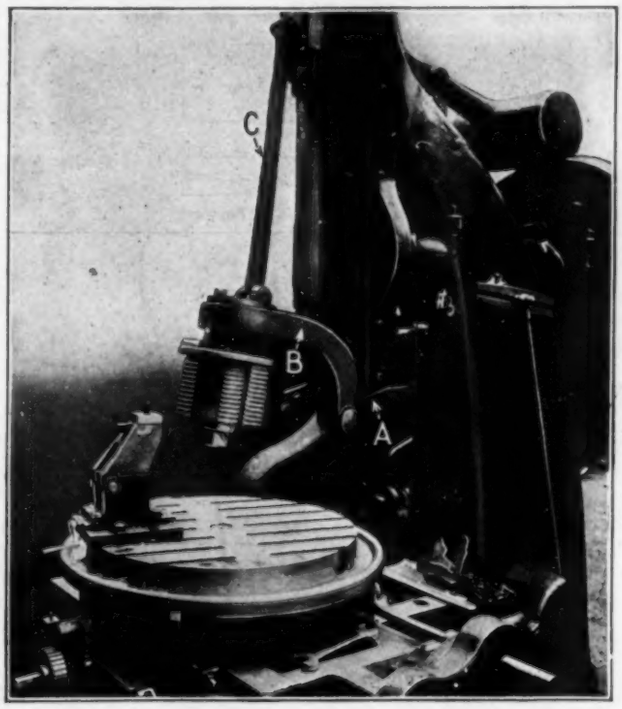


FIG. 88. BREECH-SCREW RADIAL SLOTTING ATTACHMENT

inspected; the surface must be perfectly smooth in order to permit easy extraction of the T-tube. The job is then finished on diameters in the usual way between centers, with a threaded cap on the chambered end. The extractor cuts, spanner flats and locking

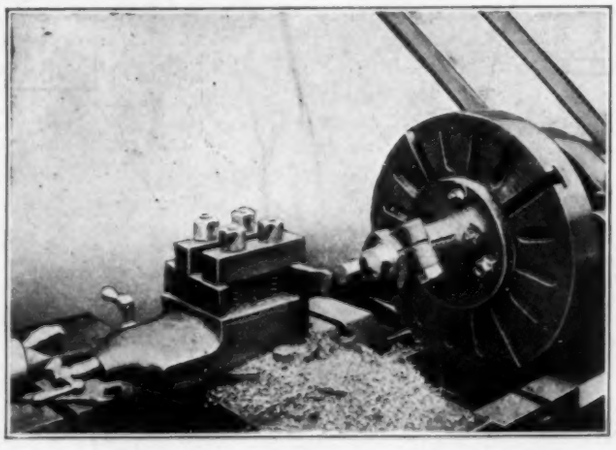
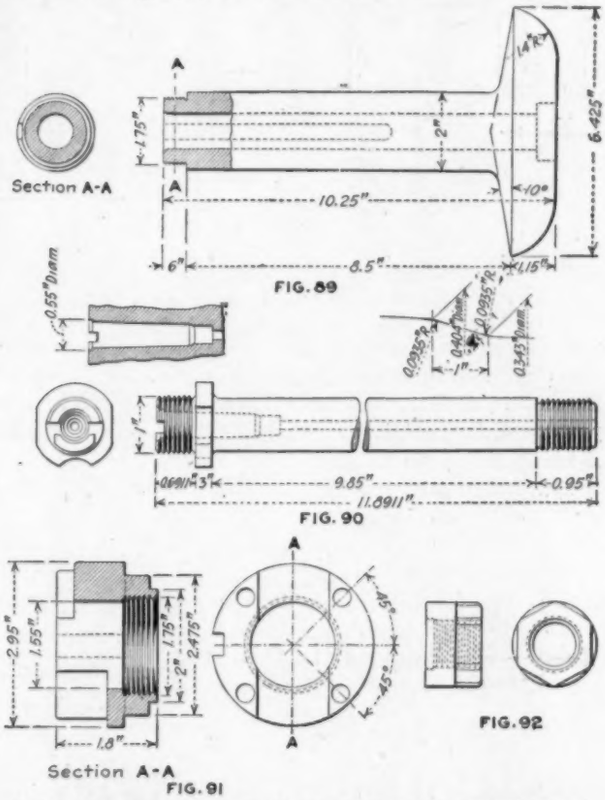


FIG. 95. CRANKSHAFT TURNING JIG

pocket are marked off when the vent bush is screwed fully home into the percussion lock. As to limits the 0.91-in. stem is to diameter plus and minus 0.0025 in., and on the chambering lengths the limits are plus and minus 0.00. The nuts, both for this spindle, Fig. 91, and for the bolt, Fig. 92, are ordinary turning jobs with limits plus and minus 0.0025 in. on the diameters in the case of the former and with a special starting point on the vertical axis for the major diameter of the thread.

The production of the safety shutter, which prevents the insertion of the firing tube until the breech screw is locked home, is, like that of the arc control, Fig. 93, an ordinary machining operation. The depth of the recess, however, is important in order to get correct compression on the vent bolt spring. Clearance for the control arc is not necessarily specially accurate, ordinarily scribed marking off being sufficient. The arc is of steel.

The steel crank, Fig. 94, actuating the screw is turned and ground on body and threaded. The keyways are then milled in a jig and fitted to a ring gage having keys. The pin is turned in a fixture in the lathe, the fixture having two keys to determine the position of the pin, thus insuring correct relationship. The fixture is offset and piloted to the faceplate; see Fig. 95. The



FIGS. 89 TO 92. PARTS OF THE BREECH MECHANISM
Fig. 89—Details of axial vent. Fig. 90—Vent-bushing spindle. Fig. 91—Axial-vent hut. Fig. 92—Nut for vent-bushing spindle

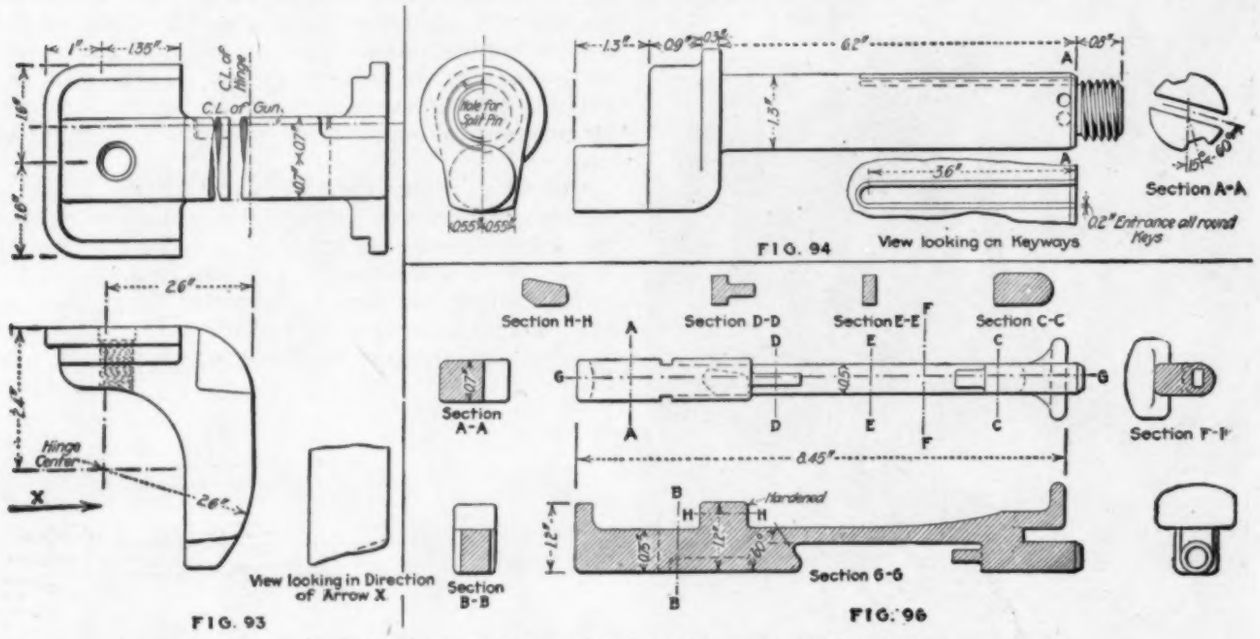
profiling round the pin is done to marking off. The pin diameter must be plus 0; it is a ring-gage fit. The steel catch lever, Fig. 96, spring-held in the breech mechanism lever, is a plain milling job.

For the breech-mechanism lever, Fig. 97, also of steel, the first operation is milling the back and boss to thickness, using a gage. Then in the lathe the boss is bored and recessed and solid keys are slotted as in connection with the carrier. The handle is turned, placed in a jig and the long hole is bored through it, the handle being bent later. The gap for the catch lever must be central and also in positive relation with the stop face toe on the lever, the toe and boss on the catch lever working in relationship with the stop faces on the carrier and catch-plate pocket. The production of the hand-lever bearing is a plain operation, the length

being bored and recessed in a turret lathe, turned on a mandrel and then with the use of a dividing head two central keyways are milled. The length from inside face to over-all is important in order that the crankshaft will not lock when tightened up. The bronze bearing for the breech-mechanism lever is shown in Fig. 98. The steel nut securing the crankshaft is a plain turning job done in a turret lathe by girls. The catch lever too is machined by girls.

The hinge pin, Fig. 99, for the carrier is of steel, a plain machining job, but having a channel cut for lubricant. The form of the oil grooves in the gun-metal-bearing washer taking the weight of the breech mechanism when it is swung to a loading position is shown in Fig. 100. This washer is between the carrier and the lower lug on the breech ring. The plate retaining the breech screw, Fig. 101, is of steel machined all over, the only important point being the rake at the front, which is milled on the circular table. The eccentric pin, Fig. 102, actuating this plate is also of steel machined all over and hardened, the view at the bottom giving a development of the groove cut in it.

Finally, the cam used in rotating the breech screw, illustrated in detail in Fig. 103, is of steel machined all over, the first operation being to mill the base and projection for the breech face on a vertical machine. The sides are milled to marking off and the piece is drilled for the screws. The job being placed on a circular jig in quantities of half a dozen or so the radii are turned and the tops faced, the base being adjusted



FIGS. 93, 94 AND 96. PARTS OF CONTROL MECHANISM
Fig. 93—Details of arc control. Fig. 94—Details of crankshaft. Fig. 96—Details of catch lever

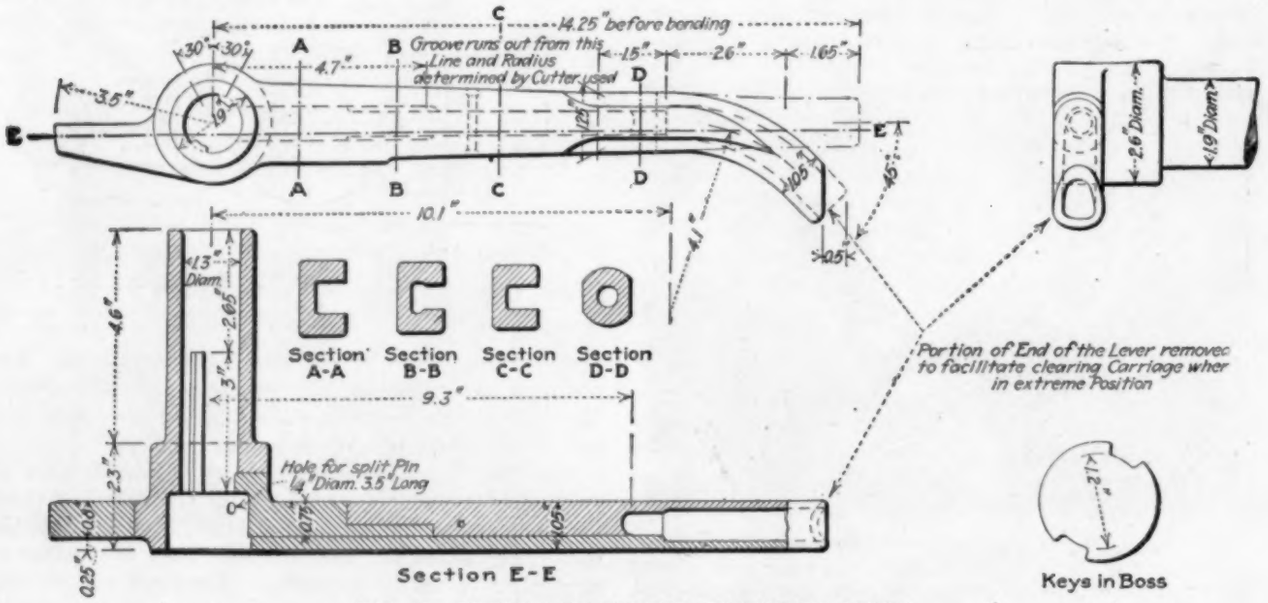
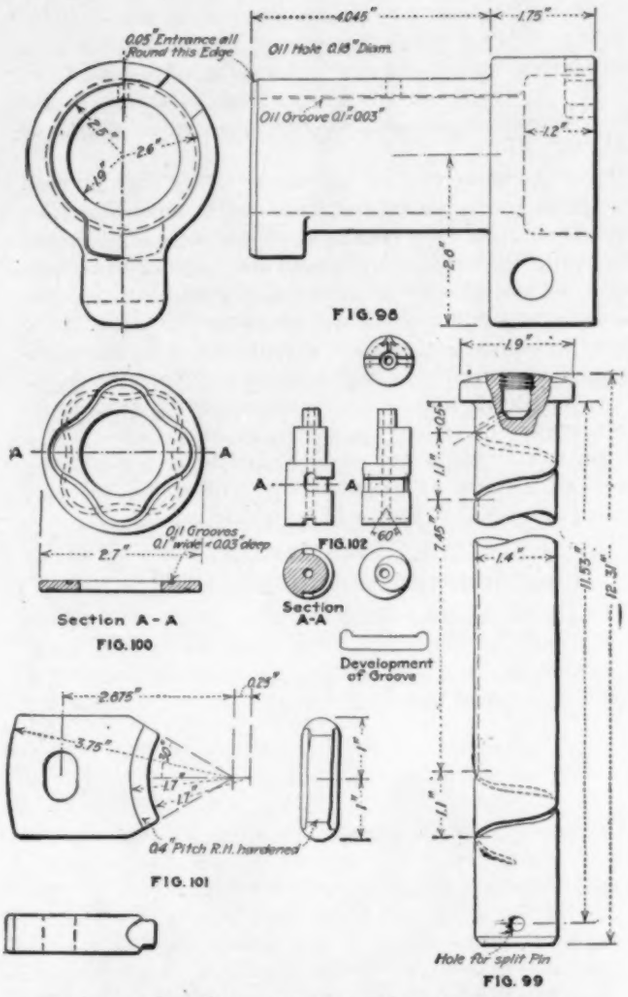

14.25" before bending
Groove runs out from this Line and Radius determined by Cutter used
Section A-A
Section B-B
Section C-C
Section D-D
Section E-E
Hole for split Pin ¼" Diam. 3.5" Long
Portion of End of the Lever removed to facilitate clearing Carriage when in extreme Position
Keys in Boss

FIG. 97. DETAILS OF BREECH-MECHANISM LEVER



FIGS. 98 TO 102. BREECH-OPENING MECHANISM

Fig. 98—Bearing for breech lever. Fig. 99—The hinge piece. Fig. 100—The bearing washer. Fig. 101—The retaining plate. Fig. 102—The plate-actuating pin

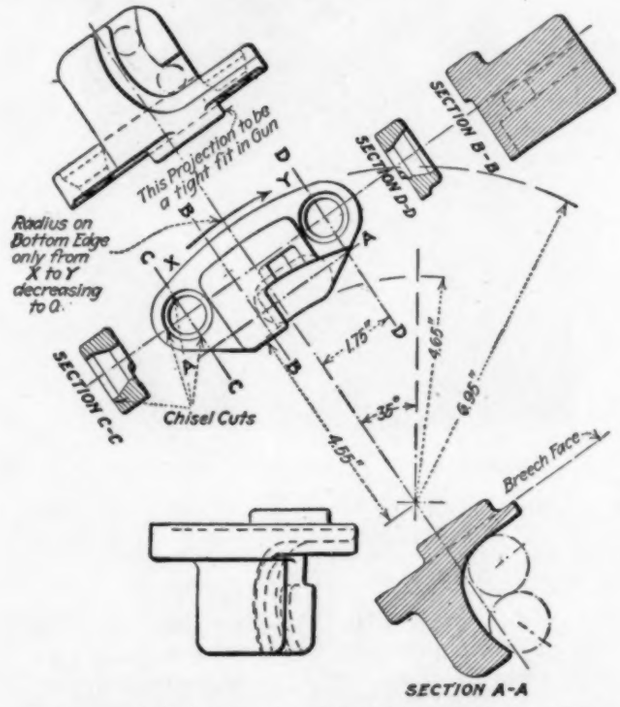


FIG. 103. CAM FOR ROTATING THE BREECH SCREW

by the fitter to suit the jig after the milling. Each job is located by the holes and by the projecting boss. It is then placed in a jig for milling the cam part and clearance for the pin, using the same base.

A number of minor details remain, but for the most part the operations on them must be described as ordinary. In the illustrations here given of the details, only leading dimensions are offered, but it must be understood that in all cases all radii are specified exactly.

For shrinkage of the jacket the A-tube is placed on

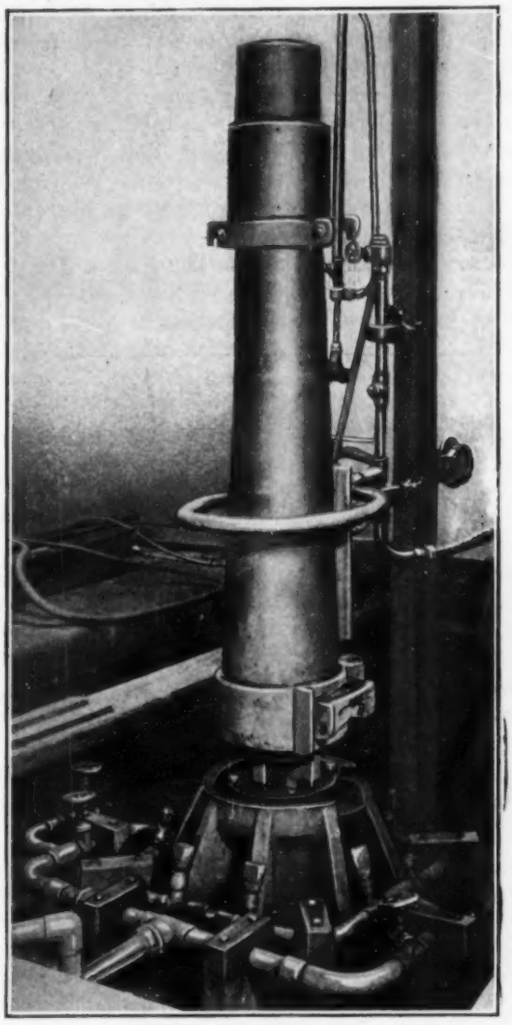


FIG. 104. SHRINKING THE JACKET ON THE A-TUBE

a stand, breech end down, and the jacket, having been raised to a temperature of 350 deg. C. at the breech end and 400 deg. C. at the muzzle end, is dropped over it. A water ring is used, as illustrated in Fig. 104, which shows the jacket, etc., in place, and the water is turned on at the breech end first, the gas ring being left over a length of about 3 ft. 6 in. at the muzzle end in order to keep this open. Simultaneously, in order to keep the A-tube cool, water is played down the bore. The water ring is then gradually raised from breech to muzzle, the whole operation occupying from 12 to 14 minutes. To check the length a rod is used, the distance being taken from the breech face to the muzzle face exact, and this length should be maintained. Another difference in practice as compared with the previ-

ous article is that rather than depend on temperatures, length gages are used in connection with the shrinkage of rings, the gage allowing for the necessary expansion by heat.

As regards the breech bush this is simply screwed into position a tight fit, so that a marked radial line is say within ½ to ¾ in. of final position; then when the breech ring is shrunk the heat travels back and allows the bush to be screwed right home.

Three complete turns are provided on the water ring, and these are of course drilled with holes for jets and connected to the ordinary water supply. The gas rings on the jacket consist of five turns about 8 in. apart, with the holes for the mixture of gas and air in two rows, staggered and at about 2-in. pitch.

To remove the jacket from the furnace a ring of mild steel is employed bearing four hinged plates, and when these are in the horizontal position they will bear on the collar of the jacket. By this means the jacket is lifted from furnace to pit by crane. The hinged pins themselves are adjustable radially by screw in order to regulate for the diameter of the jacket.

In general, inspection necessarily follows the lines mentioned in a previous article, though it is hardly so elaborate. Shop inspectors watch all processes and decide whether the results are satisfactory. They give shrinkages for the jackets, prepare the turning chart for the tubes, gage rifling, check the operations at the shrinking pit, take impressions, etc. Inspectors take the A-tube when it has been fine-bored and examine it for flaws. They check the tube in the lathe for wire seating and muzzle ring, and when the tube is wound it is gaged for horizontal and vertical diameters by girls, who also gage jackets. After the building process the body is gaged, and if satisfactory sent for final bore and turning. Though the tube is finally turned to suit the jacket the endeavor is made to standardize the wire-seating diameters on the tubes and thus keep the gun standard.

Conservation at the Scrap Pile

By P. G. Little

In our efforts looking toward conservation of material are we keeping as close watch upon the scrap pile as we should? We must all admit, however proud we may be of our productive capacity, that the combination of intensive production and inexperienced help results in a larger percentage of wasted material. At our plant we have realized for some time that this increase demanded serious consideration, and special efforts put forth in this direction have brought about a gratifying reduction of this percentage.

First we made a hard and fast rule that all scrap must pass through the salvage department to enable us to check up the amount and nature of the material going to waste. The scrap is carefully sorted and all usable parts or material returned to the shop, while the remainder that must be disposed of brings much higher prices than it otherwise would. Concerns which have given this matter only perfunctory consideration will be surprised at the saving that may be accomplished in this way. The extra revenue from our 3½ per cent. nickel steel alone pays the entire cost of the sorting department.

Different colored barrels are provided in the shop for chips of various metals, but even with the closest watch the sorting department is reporting the salvage of from 150 to 200 lb. of brass a week. Much of this is in the form of bushings that have been pressed into iron or steel parts.

Save the short ends of bar stock. They may be used for many special parts and jobs, and at the prices now prevailing it is even profitable to devise special means for using them in production work. There are times when certain grades and sizes of material are not obtainable at the moment they are needed, and on many such occasions our salvage department has kept production moving by supplying necessary material in the form of short ends or of scrapped parts that could be reworked or made over into something else.

Our conservation methods are admittedly a war measure, but in view of the unexpected returns it is more than probable that they will be continued.

Uniform for Women in the Shop

The usual costume which one sees on women workers in the machine shop today is of heavy khaki-color overall material. In warm weather they are uncomfortable because of their weight. In the Goddard & Goddard

UNIFORM FOR WOMEN IN THE SHOP

Co.'s shop in Detroit the women wear costumes of lightweight blue-and-white-checked gingham, such as shown in the illustration.

In hot weather these are more comfortable and are easier washed when dirty. Gingham has the added advantage of being cheaper than khaki and can be more readily made by those who wish to make their own clothes.

Dangerous Tools and Appliances

By CHESLA C. SHERLOCK
Secretary Iowa Industrial Commission, Workman's Compensation Service

The liability of an employer for defective tools and appliances is comparatively well known, but where the employee has been ordered into a dangerous place to work or to work with dangerous appliances many new situations arise.

A FUNDAMENTAL proposition of law is that the employer is bound to furnish the workman with a "reasonably safe place in which to work." The employer may, for all ordinary purposes, provide a reasonably safe place in which to work, but through some unusual circumstance the workman may be ordered to do work different from his usual employment. In this case, the appliances may become exceedingly dangerous to him in his new work. The question naturally arises, What is the liability of the employer?

Examination of Cases

An examination of the cases bearing on this point indicates that the liability must be based on negligence. The Pennsylvania court in 1914 decided the matter in an illustrative way. A boy of 14 years was ordered by his foreman to go on a platform about ten feet from the ground to pump oil into a tank. The only means of access to and descent from the platform were by an iron bar projecting perpendicularly from the ground and bars of iron resting on the racks under the platform and extending several inches beyond it which were used for steps. The boy was directed to use these means of getting to and from the platform. After finishing his work on the platform, he stepped on two or three projecting irons, and it was then necessary to step on top of the perpendicular bar because the bars in the lower racks were light and not strong enough to bear a man's weight. In attempting to step to this bar his feet and hands slipped and he fell on the bar and was injured. The court held that there was sufficient evidence of negligence on the part of the employer in furnishing an unsafe means of access and descent from the platform to support a verdict in favor of the injured boy.

In another Pennsylvania case the court held that the safety-appliance acts of that state may have been complied with in respect to employees following the general course of their employment, but where an employee is ordered to work in an unusual place and in proximity to shafting, a different or more extended means of guarding may be necessary. In this case the shafting was 13½ ft. from the floor and had been properly guarded so far as the workmen engaged in their ordinary duties were concerned. But the plaintiff had been ordered to work on a scaffold close to the shaft, and while so working his clothing was caught and death resulted from the injuries received. The court held that the employer was properly liable for the death.

In cases of this nature we always find the employers raising the common-law defences of contributory negligence and assumption of risk. In Washington this matter of assumption of risk and contributory negligence is ably discussed in the light of the point of law under discussion. In this case the court stated that while both the defence of contributory negligence and assumption of risk had been resorted to by employers it seemed that the proper defence was that of contributory negligence. "The servant assumes the risk of obedience, or is guilty of contributory negligence in obeying the order, only when the added danger so incurred is open, patent and obvious alike to man and master, and so plain that reasonable men might not differ as to its existence, and so imminent that a reasonably prudent man would not obey the order."

Speaking of the doctrine of assumption of risk in Indiana the court said that it is a well-settled rule that where a workman is ordered by the employer to leave his accustomed work and engage in other services for the employer, which subject him to increased danger unknown to him, he has a right to assume that the employer has used ordinary and reasonable care to make the place where he is required to perform the new and temporary service reasonably safe, and that he will at least use ordinary care to keep the place safe while he is doing the work, and it does not necessarily follow that because he does engage in such new and temporary service at the direction of the employer he thereby assumes the increased hazard or risk.

The Workman's Risk

It might be said here that before a workman can be held to have assumed the risk of a particular employment that the hazards of such employment must be reasonably well known to him at the time or be apparent to all alike. A workman cannot assume the risk of a hazard of which he knows nothing and which is not apparent to a reasonably prudent person. This is just as logical as to say that a person cannot assume an obligation unless he knows its terms in advance and makes a contract or so acts as to imply an acceptance of the terms of the obligation. The doctrine of assumption of risk is nothing more than that, although employers every day are making the mistake of pleading it in defence of actions for damages when on the face of the matter it clearly has no application at all.

In another Indiana case the court said that where the employer temporarily transfers a servant from the work he was employed to do and requires of him services involving different duties and hazards not within the scope of his employment, the servant does not assume the hazard incident thereto except such as he may ascertain by the exercise of ordinary care for his own safety.

A Washington case held that when an employee obeys an order, even without a promise on the part of the employer to repair a defective condition, he does not as a general rule assume the risk of unnecessary dangers injected in the work by the employer's negligence. If a danger is not so absolute or imminent that injury

must almost necessarily result from obedience to an order, and the servant obeys the order and is injured, the employer will not afterward be allowed to defend himself on the ground that the workman ought not to have obeyed the order.

In an Alabama case it was held that although a servant may have knowledge both of the defect and of the danger, yet if against his judgment is set the judgment of a superior, who is an expert, who commands him to go on with the work and therefore assume the risk, it then becomes a complex question whether the servant is not justified in surrendering his own opinion and obeying the command of his superior. The nature and degree of the danger, the extent of the workman's appreciation and understanding of the exigencies of the work all enter into consideration.

The Pennsylvania Law

In Pennsylvania, however, it was said that a workman cannot recover under such circumstances unless he can show that the command of his employer was such that he was actually under duress or coercion, where the danger to be encountered in doing so is at once so obvious and so serious that no ordinarily prudent person of similar age and experience would have obeyed the order. In this case, the workman drove his team over a perpendicular bank 4 ft. high and his wagon turned over upon him. It was shown that the foreman had ordered him to do this, but there was no evidence of duress or coercion as the workman could have taken his team around by other means.

In another Indiana case it was held that where an employee was directed to place a belt on a revolving pulley, something more dangerous than his regular work and in respect of which the employee was inexperienced, the employer cannot complain if the employee attempted to place the belt on the pulley without stopping the machinery and followed the plan of the experienced employees whose duties he was attempting to perform and who were better informed as to the condition of the belt than he and the method employed had been continuously used in the factory for more than a year. It was clearly the duty of such employer to instruct his employee as to the manner of doing such work.

In an Iowa case the court said: "The servant's duty is that of obedience, and when acting under an express order of the master or, what is the same, of one acting in his stead, he assumes no risk unless he fails to exercise ordinary care in obeying it."

There are hundreds of other cases on this question of assumption of risk which might be mentioned in considering the liability of the employer where the servant is ordered to work with dangerous tools and appliances. To consider them all, however, would not serve any purpose which has not already been served.

Upon the subject of the doctrine of contributory negligence we find an equally large number of cases decided upon the same point of law. In an Alabama case the court charged the jury in the following words, which is considered a very able statement of the subject of contributory negligence: "The court charges the jury that master and servant do not stand upon equal privileges, even when they have actual knowledge of the danger. The position of the servant is one of subordination and obedience to the master; and he has the right to rely upon the superior skill of the master, and is not entirely free to act upon his suspicion of danger. If a servant, being ordered into a position, obeys and is injured he will not be held to be guilty of contributory negligence unless the danger is so glaring that a reasonably prudent man would not have entered into it."

In a California case the plaintiff was employed as a roustabout in the defendant's machine shop. He was ordered by his foreman to put some compound on a belt that was revolving at a high speed between pulleys attached to a beam about sixteen feet from the floor. The foreman had placed a ladder against the beam and plaintiff climbed up to the belt, and when he attempted to apply the compound to the belt the ladder, which was so short that it stood almost perpendicularly, slipped, causing plaintiff to be thrown against a revolving shaft and severely injured. It was shown that the plaintiff had never before been called upon to apply compound to a belt; that his usual work was confined to the floor; that he was not warned of the danger, and that his attention was never directed to the hazardous risk of any task he was performing in the shop; that he did not know that he was in an unsafe position when on the ladder or that it was dangerous to be in proximity to the shaft. The court in instructing the jury, said: "I charge you that, as to the degree of the care to be exercised by the servant, you may consider the fact, if such be the fact, that such servant was acting under the direct order of his employer." The court held this to be a proper instruction and affirmed the verdict.

A Kentucky Case

In a Kentucky case a boilermaker was engaged in beading tubes in the boiler with a tool operated by compressed air. The workman reported to his foreman that the tool was defective. The foreman ordered the workman to go back to work, saying that he would get him another tool, but that it was necessary to get the boiler out at once. The workman returned to work and the same morning one of his fingers was so injured as to be permanently affected. The court allowed a verdict of $342 for damages and medical attention. The court said: "The order of the foreman was peremptory, and according to the plaintiff's evidence was accompanied with a threat that he must go on with the work or quit. What course a man of ordinary prudence would pursue under the circumstances would depend on the imminence of the danger and the reasonableness or unreasonableness of grounds for belief on his part that he might with care do the work without injury; and this is a question to be determined ordinarily by the jury from all the facts shown by the evidence. The unequal situation of the parties must also be borne in mind, and the fact that in every business hurry orders are sometimes to be filled or other emergencies to be met. If servants stopped work in the presence of every danger and refused to work temporarily at the order of the master until the danger could be removed, business could not be successfully carried on. The question of whether the servant properly obeyed the order of the master is not to be determined from one isolated fact or circumstance, but from all the facts and circumstances, and such a question a jury of practical men are peculiarly qualified to determine."

In a Montana case the plaintiff was a stationary engineer. The workman was assured by his foreman, after the engine had been repaired, that it was all right with the exception of a tension spring. As soon as the engine was started, however, it became apparent that something was wrong. The engineer attempted to tighten the tension spring while the engine was running, thinking that it was the only part in defective condition. It developed that the real trouble was due to a broken bracket. As a result, the plaintiff's hand was badly mangled as a proximate result of the broken and defective condition of the bracket. The court said: "The plaintiff's situation was not materially different from what it would have been had the foreman specifically ordered him to attempt to tighten the tension spring with his fingers while the engine was in motion. The evidence is all to the effect that if the trouble had been caused by a loose tension spring it could have been cured safely by the method adopted by the plaintiff. The real difficulty was with the broken bracket, and owing to the engine's vibration this could not be discovered until the engine was running under a load. Under these circumstances the plaintiff may properly invoke the rule that 'if the master orders the servant into a situation of danger and in obeying the command he is injured the law will not charge him with contributory negligence unless the danger was so glaring that no prudent man would have entered into it even under orders from one having authority over him.'"

It is evident from these cases that where a workman is ordered by his employer to work in a dangerous place, or with dangerous tools, that the employer cannot escape liability by raising the common-law defences of contributory negligence or assumption of risk. The proper defence appears to be, where any defence is to be raised, that of contributory negligence. Even then it cannot be raised unless the defective condition of the tools or appliances was so glaring as to be apparent to all upon even the slightest inspection.

Where it can be shown that the workman was not familiar with the new work and had no knowledge whatever of it or the tools to be used then this defence could not be raised.

Trying to Thicken the Edges of a Disk

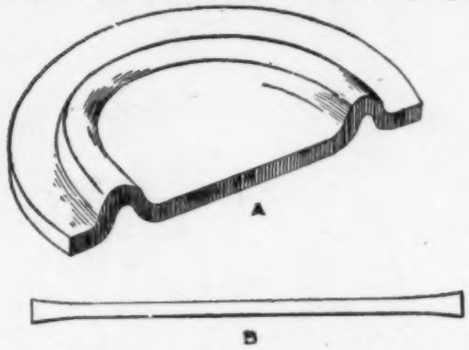
By Joseph A. Ahlers

There is one operation on draw-press work the idea of which is clever and the theory of which is logical, but attempts to accomplish the desired result with it seem futile.

The operation is this: To thicken the metal on the outside edge of a blank, a bead is formed near the edge as shown in the sketch at *A*. This draws the metal from the center to the bead. The next operation flattens this out toward the outside, making the metal thicker and producing a blank as shown at *B*. Blanks of this nature are used on munition work and on many shell parts.

The scheme is very clever but not at all practicable. The wrinkles which are caused by this beading operation refuse to be removed or ironed out by subsequent drawing operations, and on work which must have a high-grade finish these wrinkles will not pass.

I have seen as many as a half dozen attempts to use this method and each one resulted in failure. It has been tried by a private firm on a booster casing for 3-in. shells, and after several hundred dollars' worth of dies were scrapped and several toolmakers discharged, the hope of obtaining results was abandoned. As many as nine subsequent drawing and beading operations



AN UNSUCCESSFUL OPERATION

will not iron out the ridges, and it is doubtful if twice that number would do it. At best the science of deep drawing is only in its experimental stages, and if any manufacturer or engineer would be benefited by the experience of six different designers he will avoid this scheme and save the cost of discarded dies.

Efficient Machining of Base-Cover Groove

By R. S. Myers

The tools shown in the sketches were designed for cutting the base-cover groove in 4.7-in. shells. The work was done in a LeBlond lathe, the shell being held in

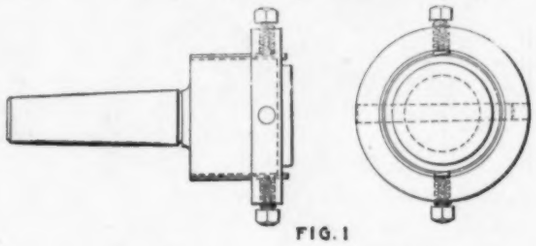


FIG. 1

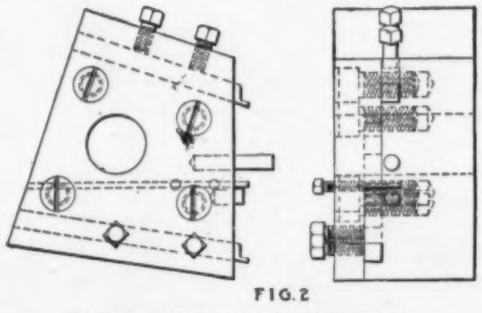


FIG. 2

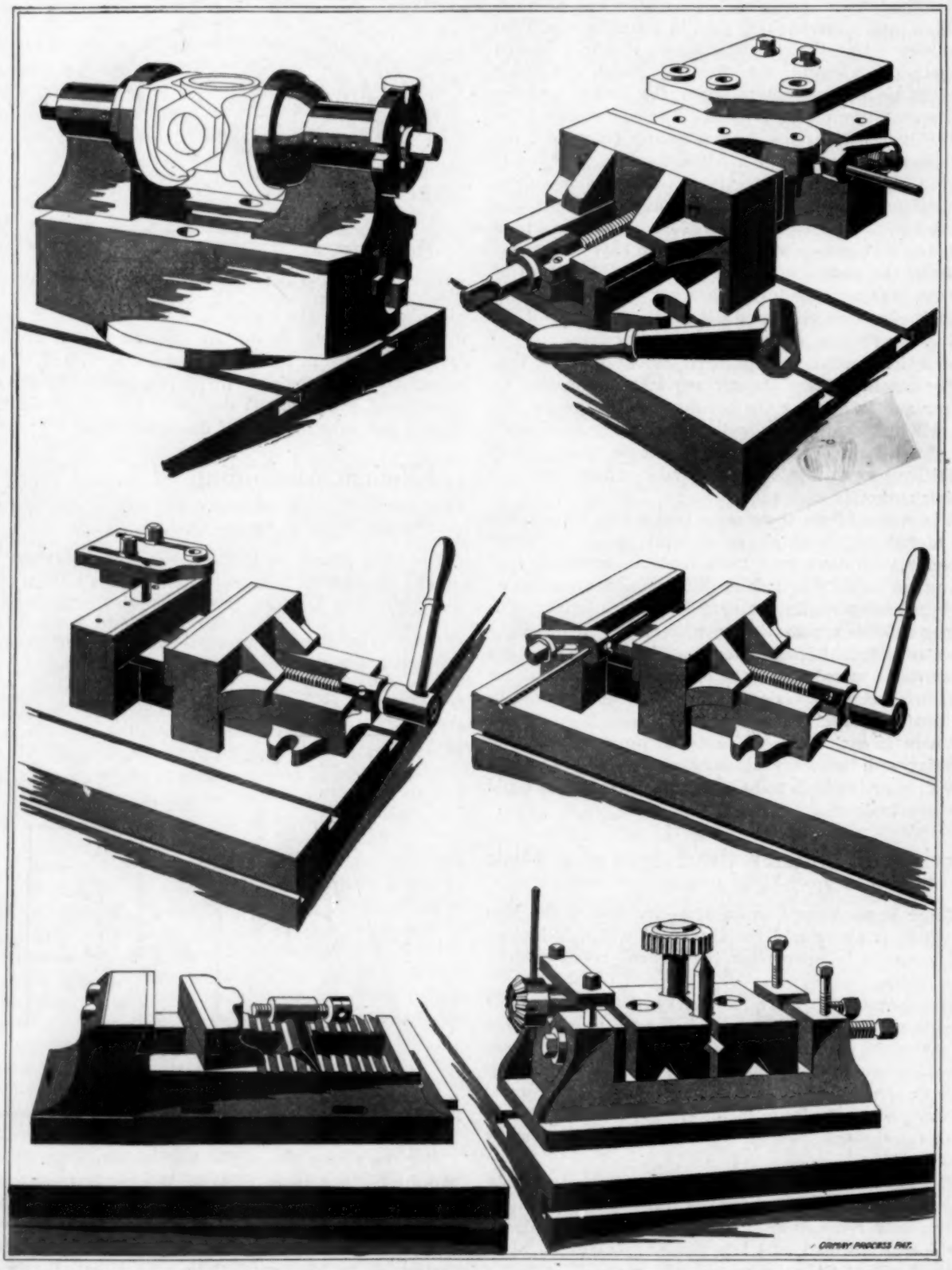
FIGS. 1 AND 2. THE TWO TOOLS

a pot chuck. The roughing of the groove is done by the tool, Fig. 1, held in the tailstock.

For machining the angles the box tool, Fig. 2, with two high-speed tools held in the position shown is clamped in the lathe in the position usually occupied by the regular toolpost. The compound rest is swung around to the required angle to machine the sides of the groove to 17 deg., 45 min. and 9 deg., 6 min. respectively.

FOR SMALL SHOPS *and* ALL SHOPS

By J. A. Lucas



VARIOUS METHODS OF HOLDING WORK

Making Hosiery-Machine Parts

By ROBERT MAWSON

This article illustrates and describes the sequence of operations in milling certain members of hosiery machines as practised by the Hemphill Manufacturing Co., Pawtucket, R. I.

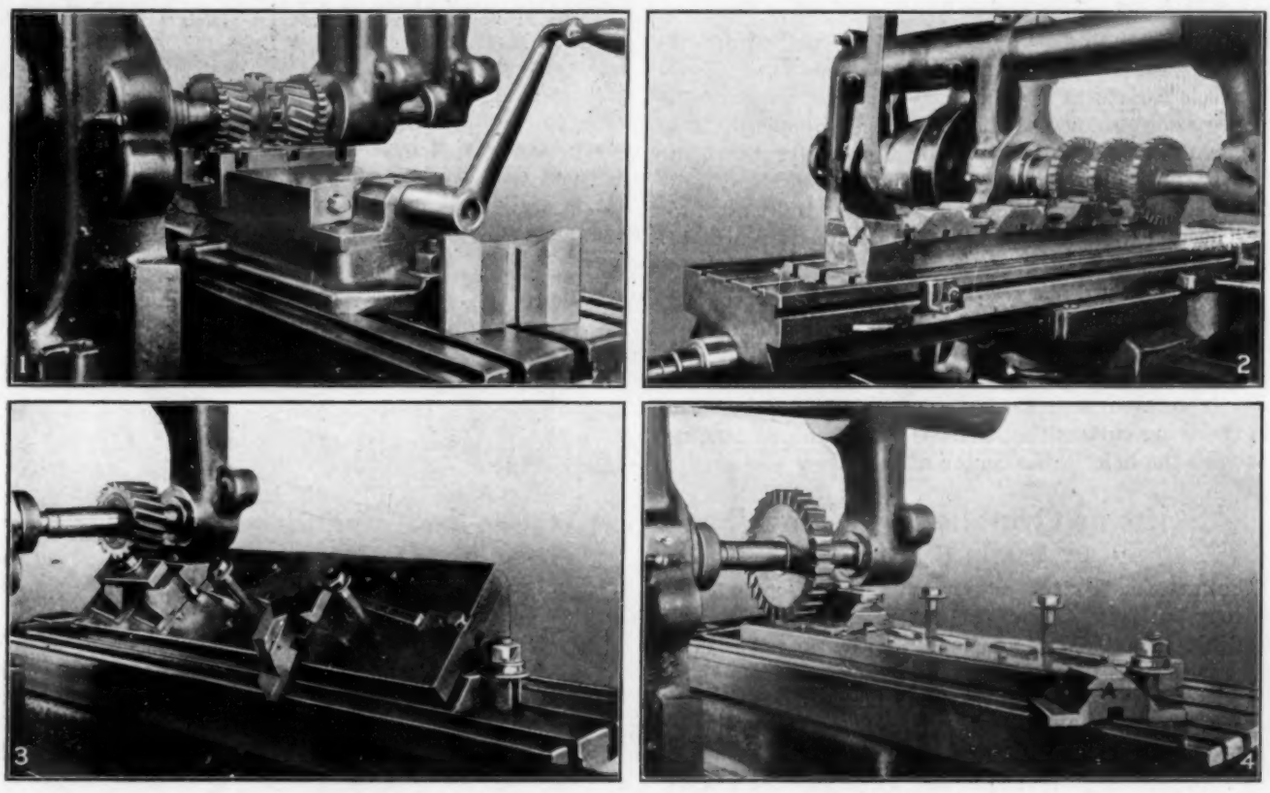
IN THE first example four operations are employed to obtain the requisite finish. The finished surface resulting from the first milling operation is used as a locating point for all subsequent operations, this principle, which is sometimes called unit location, tending to insure interchangeability, rapid production and, to a certain degree, simplified tool design and standardization of tool equipment.

The other example described is a quadrant gear, and in this all of the milling work is done at one setting.

It might be well to mention the advantage of this simple form of milling fixture—vise jaws. The writer has often seen expensive fixtures used for machining operations, especially in milling, where an ordinary vise arranged with special jaws could have been used to advantage. The jaws are cheaply made, and when fitted to the vise afford a handy and sure means of holding the part securely for the work.

In Fig. 2 is shown the machine set up for the second milling operation. The locating surface is the keyway machined in the preceding operation, and the fixture is designed to hold eight cam blocks at once.

When the parts are in position they are held by straps and bolts placed between each pair of blocks. The work performed in this second operation is the milling of the sides, top and recess. Three side-milling cutters 6 in. diameter by $\frac{3}{4}$ in. wide, two plain-milling cutters



FIGS. 1 TO 4. MILLING OPERATIONS ON CAM BLOCK

A finish-bored hole is used for locating the casting, and when the fixture is correctly set on the circular-milling machine table it is revolved and the surfaces of the arc is machined.

The example used to illustrate the principle of multiple milling is the cam block, which is held for the first operation in an ordinary milling-machine vise, to which special jaws have been fitted. The ends, bottom and keyway of the cam block are machined at one pass, two side-milling cutters $3\frac{1}{2}$ in. diameter by $\frac{1}{2}$ in. wide, two plain-milling cutters $2\frac{3}{4}$ in. diameter by $1\frac{1}{4}$ in. wide, and one plain-milling cutter $3\frac{1}{2}$ in. by $\frac{1}{2}$ in. wide being used. The operation is shown in Fig. 1.

2 in. diameter by 2 in. wide, and two plain-milling cutters $2\frac{3}{4}$ in. diameter by $\frac{11}{16}$ in. wide being used.

The third milling operation on the cam block is illustrated in Fig. 3. The parts are again located by the keyway, six blocks being machined at one setting, one strap placed between each two pieces constituting the holding-down medium, and a plain-milling cutter 3 in. diameter by $1\frac{1}{2}$ in. wide is used.

The fourth and final milling operation is performed with the machine and fixture shown in Fig. 4, in which the same method of locating and holding the parts is followed. It will be observed by referring to *A*, which is one of the finish-machined parts, that the surface

machined on the flange is wider at one end than the other, and to provide for this the locating tongues are placed at an angle on the fixture, as shown. The cutter used is a side mill 7 in. diameter by 1½ in. wide, and six castings are milled at one setting. A finished cam block

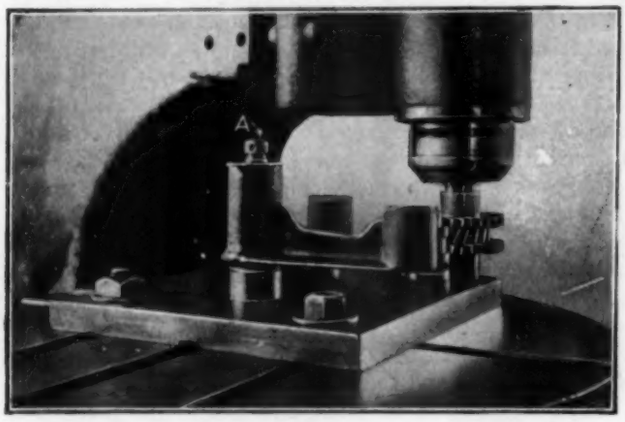


FIG. 5. MILLING THE SURFACE OF THE ARC

is shown in front of the milling fixture and the number of surfaces operated upon may be observed.

On some parts it is found advisable to machine all the necessary surfaces at once, and an example of this is shown in Fig. 5. The part is the quadrant, which must be milled on both sides. The casting has been previously bored and is located by a pin *A* fitting into it. The outer end of the casting rests on two pins to assist in holding it.

The cutters used are two side mills 4 in. diameter by ½ in. wide and one plain mill 3 in. by ⅝ in. wide. The fixture is fastened on the table so that the locating pin *A* is at the axis of rotation. To machine the part the table is rotated, and as the quadrant is fed between the revolving cutters the surfaces are machined concentric with the hole in the center of the piece.

"Skirts or Overalls for Women"

By Martin H. Ball

The article "Skirts or Overalls for Women," by Entropy, on page 487 of the *American Machinist* was very interesting. While on many of the points taken I agree with him, I have always thought that women sacrificed some of their efficiency and much of their comfort and health by their endless search for clothing that would attract and hold attention and that they blindly followed fashion even though the latter was not always graceful.

When women commenced to work in the shops and donned such attire as they deemed fitted to their new surroundings I felt that they had taken a step in the right direction and hoped that it would lead to a more plain and uniform dress for all occasions.

In regard to the linen dusters worn by men, my observations lead me to believe that they are worn principally because the wearers think they look better in them and expect to be classed in a somewhat higher plane than their brother workman in overalls and jumper; but the fellow who really wants to work and wants all the freedom obtainable does not usually put himself inside a duster.

A well-fitted apron affords all the protection needed in many classes of work. The waist and neck bands should be comparatively weak, so that these fastenings may give way if any part of the garment becomes entangled.

In many shops women are running overhead cranes and are climbing up ladders to the operators' cage in the same way that men do. This surely is a task that would cause most women in skirts to hesitate to do it. Even in the best organized and equipped factories there are many places that the operatives must pass where the corners and projections are more or less sharp and can be avoided more easily and safely in a close-fitting garment.

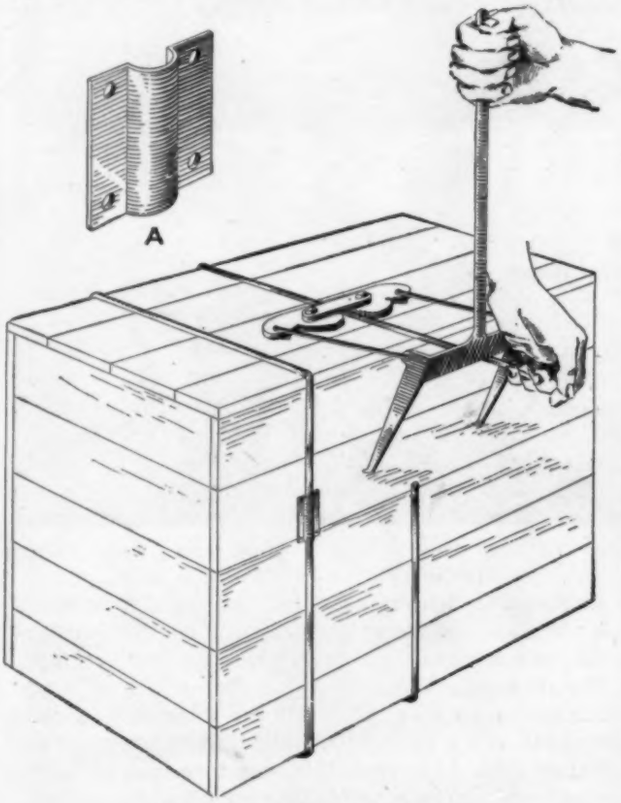
But why should we try to tell the women what they should wear—especially in these days when they are proving their ability to do things that we have heretofore been unwilling to let them try? Women have now been working in our shops long enough to have decided upon what is best for themselves, and I believe they will be glad to tell us now that they know we are interested. Let us leave it to them.

Wire Tightener for Strapping Shipping Cases

By J. A. Lucas

Where wire is used for binding packing cases to prevent them from bursting open in transit the device shown in the sketch is most convenient.

It is easily and quickly made from a few odds and ends and will enable the shipper to draw the wire



WIRE-STRETCHING DEVICE

tight enough to be of real service as a retainer. Its construction and use is very clearly shown in the cut.

The piece shown at *A* is a clip of sheet metal designed to cover the joint in the wire.

Airplane Motor-Ignition Systems

By B. Z. REITER

In view of the great demand for men who understand airplane-motor work and the fact that ignition is such a vital point in successful operation, we have secured this article from an engineer who is experienced in this class of work. While some parts may appear elementary it must be remembered that unless the principles are thoroughly understood no real progress can be made toward becoming an expert in the work, as it requires men with intelligence and education. Many foremen and other executives are going into this division to do their share in the great struggle.

TWO principal ignition systems are used in airplane motors, battery ignition and magneto ignition. The current for the battery-ignition system is supplied from dry batteries, storage batteries, direct-current generators; magneto ignition employs low-voltage alternating-current generators and high-voltage alternating-current generators. For airplane motors the main sources of ignition current are the storage batteries and high-tension alternating-current generators or magnetos, while storage cells are used for starting purposes only.

The Battery Ignition

In the battery-ignition system the battery current is transformed by an induction coil into a current of a very high voltage, which leaps across the gap at the sparkplugs and thus produces a spark to ignite the mixture. The induction coils are divided into vibrating and nonvibrating coils. The vibrating coil delivers a shower of sparks at the gap in the sparkplug, whereas the nonvibrating coil delivers but one spark for each ignition. The functional parts of a battery-ignition system with vibrating coil for a four-cylinder motor are shown in Fig. 1. Central cores of soft No. 20 gage iron wire are wound with 150 to 300 turns of insulated copper wire of from No. 16 to No. 20 B. & S. gage. This large-sized and low-resistance wire winding is called the primary coil. Outside of the primary coil there is a winding of 20,000 to 30,000 turns of copper wire, usually about No. 36 B. & S. gage, which is called the secondary coil. One end of the secondary coil is connected to the framework of the motor and the other end is connected to the terminals of the sparkplug. The function of the sparkplug is simply to create a gap in the motor cylinders in which the spark can occur. This gap should be of proper width to absorb the maximum energy that the ignition system will produce.

The primary coil is connected to a magnetically operated circuit or contact breaker called a vibrator. Its function is to interrupt, or break, the primary current at the proper time. Assume that the primary circuit is closed, then the current flowing through it will cause the central core to become magnetized. Break the current and immediately the core ceases to be a magnet and the breaking, or stopping, of the flow of the current in the primary coil will cause or induce a current with a very high voltage—20,000 to 30,000 volts—in the secondary coil, so that the voltage or pressure will be sufficient to jump the gap in the plug.

This breaking of the primary current is accomplished as follows: The metal block *B*, Fig. 1, is mounted on the end of fairly rigid springs *S* which keeps it normally in contact with the screw *P*. The primary current flows from the battery through the screw *P* to the block *B* down to the spring *S* and up through the primary coil and back to the battery.

This flow of electricity causes the core to become magnetized and to attract the block *B* away from the screw *P*. This movement breaks the primary current and causes a spark at the sparkplug points. With the current now cut off, the core ceases to be a magnet and the spring *S* forces the block *B* back to make connection again with the screw *P* and so the whole action occurs over again. To the primary circuit on the opposite side

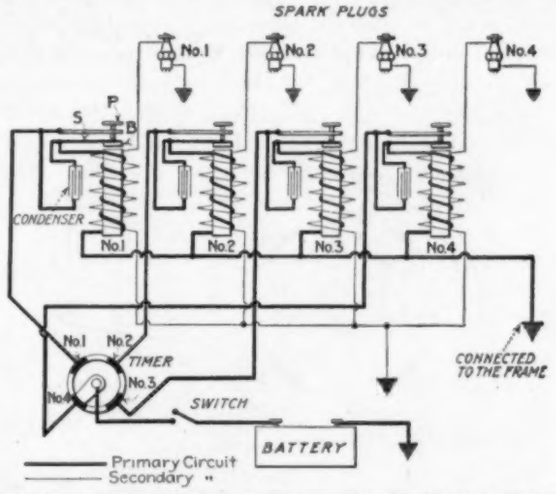


FIG. 1. A FOUR-CYLINDER BATTERY-IGNITION SYSTEM

of the circuit breaker is connected the condenser. When a circuit through which current is flowing is broken suddenly it is difficult to stop the surge of the current when the break takes place at the circuit-breaker points and prevent it from jumping across and causing sparks. This sparking of the circuit-breaker points would mean that a certain amount of current is being wasted. This waste retards the demagnetization of the central core and causes the current which is induced in the secondary coil to be of less pressure.

In order to avoid this a condenser is incorporated, which consists of many layers of thin tin foil insulated from each other by waxed paper. In place of the current passing across the points of the circuit breaker it passes into the condenser, which stores it. It is very important to have a condenser with the right capacity to absorb the current, for if the condenser capacity is too great it will absorb too much current, thus robbing the sparkplug and preventing the spark from being as hot as necessary for certain ignition.

As long as the spark must occur only at the proper time in the cylinder and the current must be distributed to the proper sparkplug, a contact maker, or "timer," is used. Fig. 2 shows a timer for a four-cylinder motor. Nos. 1, 2, 3 and 4 terminals are connected to the primary winding of each of the coils, there being generally a coil for each cylinder. Roller *R* is mounted on the extension of the camshaft or is geared to it and revolves at one-half the crankshaft speed. As *R* revolves in the outer casting *C* it alternately establishes contact between the insulated segments *S* and the metal of the engine. This distributes the current to the proper sparkplugs. The timer, by means of the lever *L*, is adjustable so that the spark shall occur earlier or later as compared with the movements of the motor, by which arrangement it is possible to produce the spark either after the piston has passed the dead center, "retard spark," or before it reaches the dead center, "advance spark."

Referring to the primary winding it of course has a switch in the circuit located at some convenient place.

The ignition system shown in Fig. 1 has a circuit breaker, or vibrator, for each cylinder. This means that it is necessary to adjust each vibrator to get sparks of equal intensity in each cylinder. To overcome this difficulty Fig. 3 shows an ignition system where only one vibrator is used in place of a separate vibrator in the coil units. This vibrator is known as the master vibrator, the demand for such device having been brought about by the difficulty in securing uniform

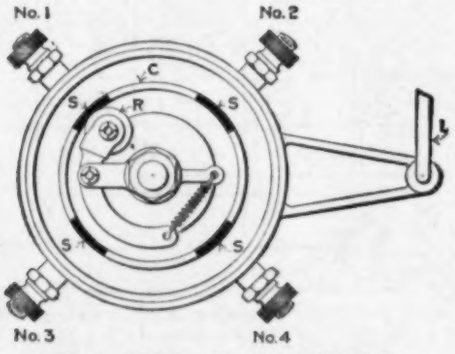


FIG. 2. TIMER OR DISTRIBUTOR

adjustment of the vibrator points either from their deterioration or from defective condensers.

If the circuit breaker is operated mechanically the ignition method is known as a nonvibrating-coil system. This system is made up of a battery, a coil without vibrator, a mechanically operated circuit breaker which is also the timer, a condenser and a distributor. Fig. 4 shows the wiring diagram of a nonvibrating system for a four-cylinder motor. To the primary coil is connected the condenser, the battery and the circuit breaker. To the secondary winding is connected the distributor and the sparkplugs. There are two main points of difference between the vibrating and the nonvibrating coil systems. The nonvibrating system has only one set of coils and the secondary coil is connected to the distributor which directs the current to the proper sparkplugs.

The action of the system is as follows: The circuit breaker closes the primary circuit and the iron core becomes magnetized. A very short space of time is necessary for the current to rise to full value, the actual time depending on the construction and material of the coil. When the circuit breaker is opened and the primary winding is broken the core ceases to be a magnet. This induces a very high voltage in the secondary coil. The faster the primary circuit is broken the greater will be the voltage in the secondary coil.

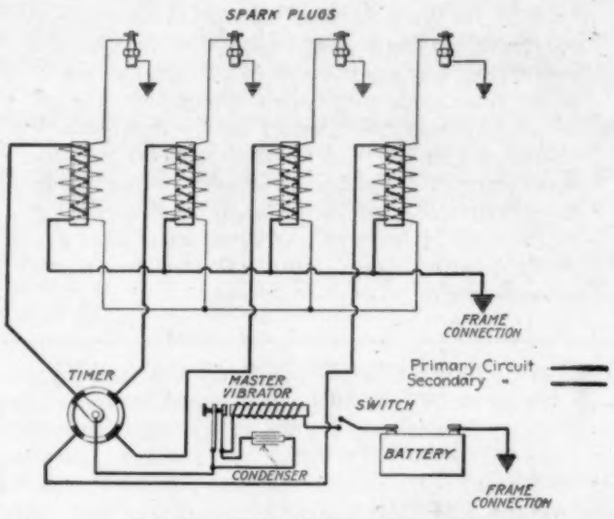


FIG. 3. THE MASTER VIBRATOR

The high-voltage current is then distributed to the proper sparkplugs where it jumps over the gap in the form of an arc.

The most important parts of the battery-ignition system—the coils and the circuit breaker—require very little attention except an occasional inspection of the circuit breaker or vibrator points to see if they have the proper adjustment and contact. In time it may

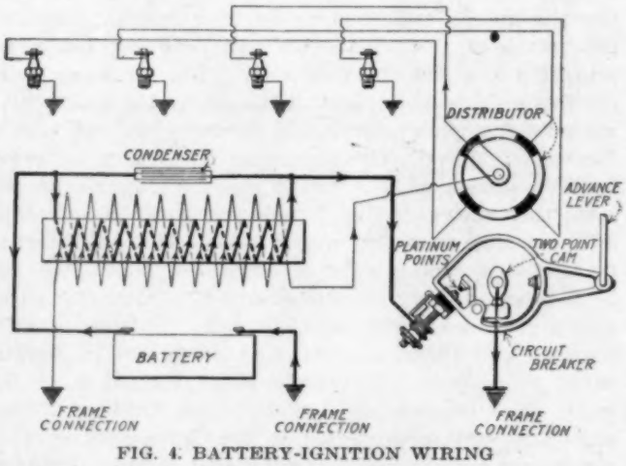


FIG. 4. BATTERY-IGNITION WIRING

become necessary to smooth the ridged or pitted surfaces of the contact points. For this purpose it is advisable to use a small jeweler's file or fine sandpaper rather than that emery cloth should be used. The coil should be kept as free from moisture as possible because the moisture reduces the efficiency of the insulation.

The proper adjustment of the vibrator is important, as the life of the battery and the quality of spark are influenced thereby. The gap between the points should not be too large as the vibration will be too slow; neither should it be too small as that will cause too

rapid vibration, which will waste the current. In practice the adjustment should be made as follows: Unscrew adjusting screw until the vibrator stops buzzing; then turn the screw down slowly until the two points just touch, followed by an extra quarter turn or until the vibrator emits a rather low buzz; then continue screwing down until the vibrator gives a high-pitched tone.

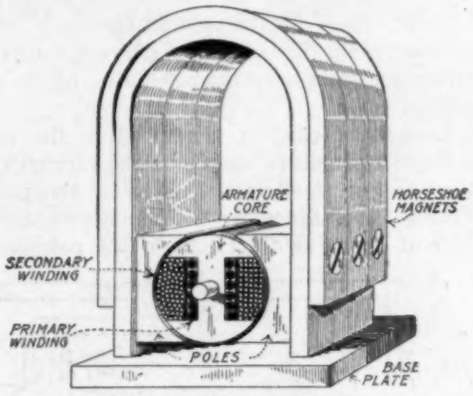


FIG. 5. THE MAGNETO

In the magneto ignition system the necessary magnetizing energy of the electric current is directly produced by a magneto-electric machine known simply as the magneto. The magneto as a producer of electric current is constructed on the theory of magnetism. When an electric current is passed through a hard-steel bar the bar becomes permanently magnetized. The magnetic properties of the steel bar cause a magnetic field around it, which is strongest at the ends, or poles. of the poles near together and giving them the form of a horseshoe. When a wire is passed between the poles of the horseshoe magnet it cuts across a number of lines of force in the magnetic field. This cutting the lines of magnetic force sets up a current in the wire, which fact is made use of in the magneto by rotating a coil of wire between the poles of a magnet and so cutting the lines of force, thus generating a current of electricity in the coil. If a single coil is rotated in the magnetic field the generated current is one of low tension

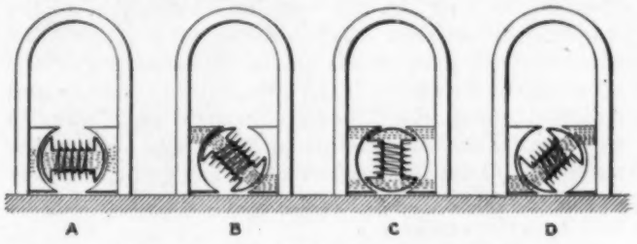


FIG. 6. THE MAGNETO IN ACTION

and the magneto is known as the low-tension magneto. Under the name of high-tension magnetos are included those in which both the primary and secondary coils cut the lines of force between the poles of a magneto. As only high-tension current is used for airplane-motor ignition, we will discuss in the following only those ignition systems where the electric current is generated by a high-tension magneto.

The essential parts of the high-tension magneto are shown in Fig. 5. The magnet is usually made of six pieces of hardened steel of horseshoe form. Magnets made in this way are much stronger and retain their

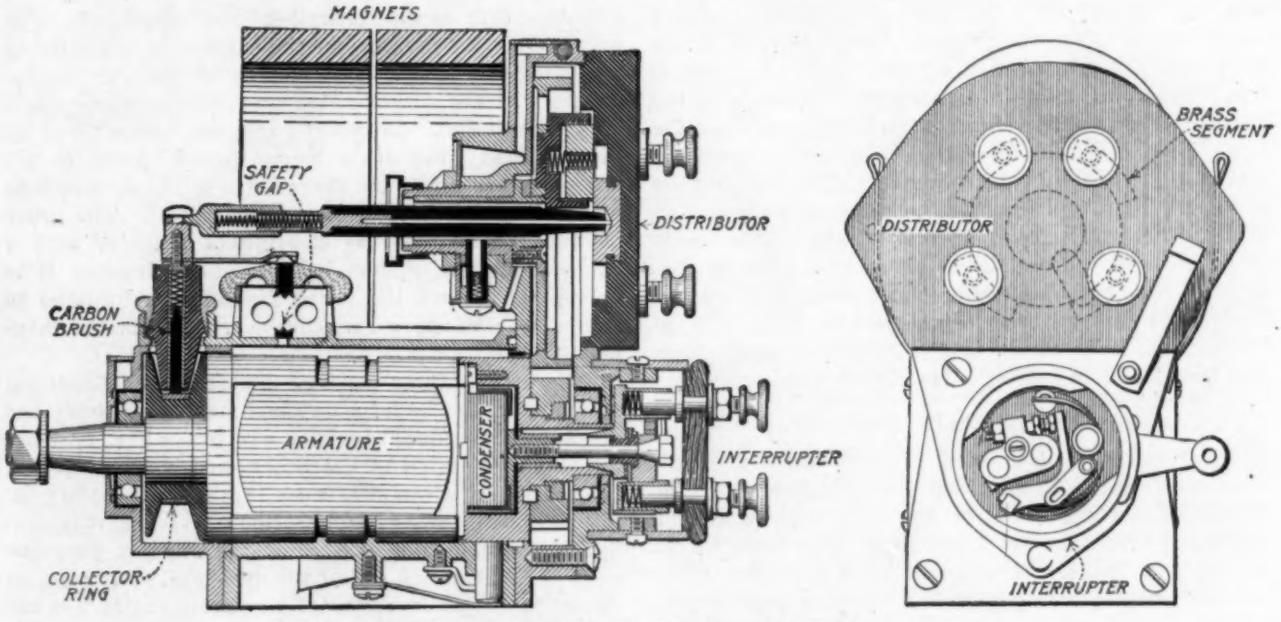


FIG. 7. BOSCH HIGH-TENSION MAGNETO

It is generally known that magnetism acts in the nature of a stream of current, and this is conventionally represented by lines of force which always flow out from the pole called the north pole of the magnet and around into the other, or south pole, thus forming a complete circuit. The strength of the magnetic field depends on the number of lines of force or in the concentration of those lines in the magnetic field by bringing the ends magnetism longer than a single magnet. The poles of the magnet are fitted with polepieces, which receive the magnetism from the ends of the magnets. The primary and secondary coils are wound on an H-shaped armature made of a number of soft iron pieces. The primary coil lies next to the piece connecting the two curved ends. The secondary wiring is much finer, has more turns and is wound outside the primary. For supporting the

magnet, polepieces and armature a nonmagnetic base is used.

The principles of electric generation are shown in Fig. 6, where four positions of the armature are illustrated showing the current flow through the armature. In position *A* the magnetic lines are shown passing through the winding of the armature. In position *B* they are shown passing through the armature coil, but in diminished strength. In position *C* they are shown passing across the ends of the armature core and not through the winding, and causing interruption of the magnetizing current. The voltage of the generated current reaches its maximum in this position of the armature. In position *D* the armature has been turned so that the magnetic lines pass through the winding in the opposite direction to that in *B*. In this position the magneto will deliver the best spark and will correspond to the extreme advance, while position *D* will correspond to the extreme retard.

The use of the magneto as a source of current for ignition requires the system to be furnished with a condenser, circuit breaker and distributor so that the current generated in the armature winding shall be converted, through the circuit breaker, into high-tension current and be distributed to the proper sparkplugs. Fig. 7 shows a magneto in which the condenser is included in the rotating member. The interrupter, or circuit breaker, is mounted on the armature shaft, revolving with it. By having the circuit breaker, condenser and primary winding on the armature the entire primary circuit is contained in the armature.

During the period of rotation, when the magnetic lines of force are passing through the armature core (see Fig. 6, position *C*), the interrupter points are closed and short circuiting the primary current results. Since the primary circuit is closed, a considerable current will flow through it. At approximately the instant when the pressure of generated current would be the maximum the interrupter breaks the primary circuit and so produces a very high voltage in the secondary. The high-tension current is led to an insulated collector wheel revolving with the armature, from which it is collected by means of a carbon brush and taken along to a rotating distributor placed just above the circuit breaker. Here it is distributed through brass segments (set in an internal cylinder made of fiber) to the respective sparkplugs. The distributor is geared to the circuit breaker.

The Safety Gap

A safety gap is connected in the secondary circuit to protect the insulation of the armature and the current-conducting parts of the apparatus in case a sparkplug should be short circuited, or a cable should be taken off while the magneto is in operation. The gap between the points is made very much greater than in the sparkplugs, so that in case of an electric discharge it shall take place at that point.

The wiring diagram of a high-tension magneto system for a four-cylinder motor is shown in Fig. 8. One end of the primary coil is connected to the armature, and the other end passes through the core to the circuit breaker and returns just below the condenser, completing the circuit. At the circuit breaker the current is broken by the right-angled crank *C* pivoted at *P*. One end *L* of the crank, when rotating, strikes against the raised pieces *A* in the cover, thus opening the platinum points *K*. After *L* has passed *A* a spring *S* acting on the crank *C* closes the points *K* again. One end of the secondary coil is connected to the insulated end of the primary coil so that the one forms a continuation of the other. The other end of the secondary coil leads through the collector and brush to the distributor from which the current is distributed to the proper sparkplugs. As the sparkplugs are grounded to the motor frame the secondary current returns back to armature core and so to the beginning of the secondary winding.

The strength of current generated in the magneto depends on the armature speed, on the strength of the permanent magnet and on the shape of the polepieces and armature core. Since in a given magneto there is no possibility of changing the shape of the polepieces, the

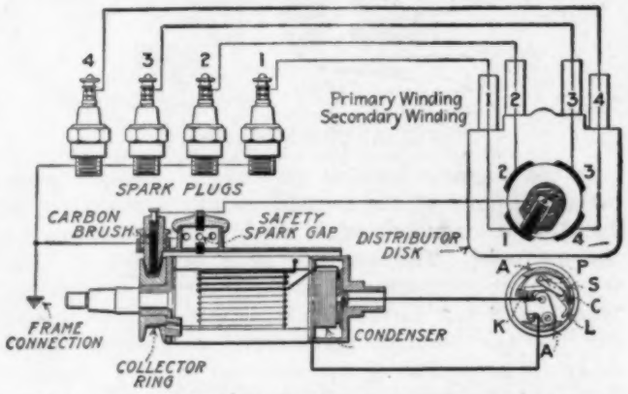


FIG. 8. WIRING DIAGRAM OF HIGH-TENSION MAGNETO

armature core or the strength of the magnet, the only way to vary the pressure of the current is by changing the armature speed. The voltage of the current increases with the increasing numbers of revolutions made by the armature. In other words the spark given by the magneto when it is being turned slowly is not hot enough to ignite the charge, due to the slow cutting of the lines of force by the primary coil. The proof of this fact is that the starting of a motor with a magneto-ignition system has difficulties because it is impossible to turn the motor fast enough by hand to secure a satisfactory sparking current from the magneto.

To overcome these starting difficulties some ignition systems combine both battery and magneto systems and are known as "dual" ignition systems. Fig. 9 shows the wiring diagram of the Bosch dual-ignition system. It consists of a complete nonvibrating coil battery-ignition system, using the distributor of the magneto-ignition system and a vibrator for starting purposes only. The induction coil of the dual-ignition system, as shown in Fig. 9 in sectional view, consists of a cylindrical housing mounted on a brass casting, the flange of which serves to attach the coil to a board or other part of the airplane. The coil is provided with a key and lock by which the switch *S* may be locked to prevent the unauthorized operation of the engine. By placing the switch *S* at position marked *A* the ignition will be by battery or by magneto if the switch is placed at position marked *M*.

The dual-ignition system gives an advantage in starting the motor by simply switching on the current. As-

sume, for example, that the motor has been stopped by switching off the current, leaving the cylinders filled with a proper mixture for firing. By switching in the battery and pressing on the button *B* of the coil the platinum point of the vibrator *P* are brought into contact and the vibrator commences to act, breaking the current in the primary, inducing a sufficiently high-voltage current to jump the gap in the sparkplugs, fire the charge and thus start the motor. It should be noted that the spark

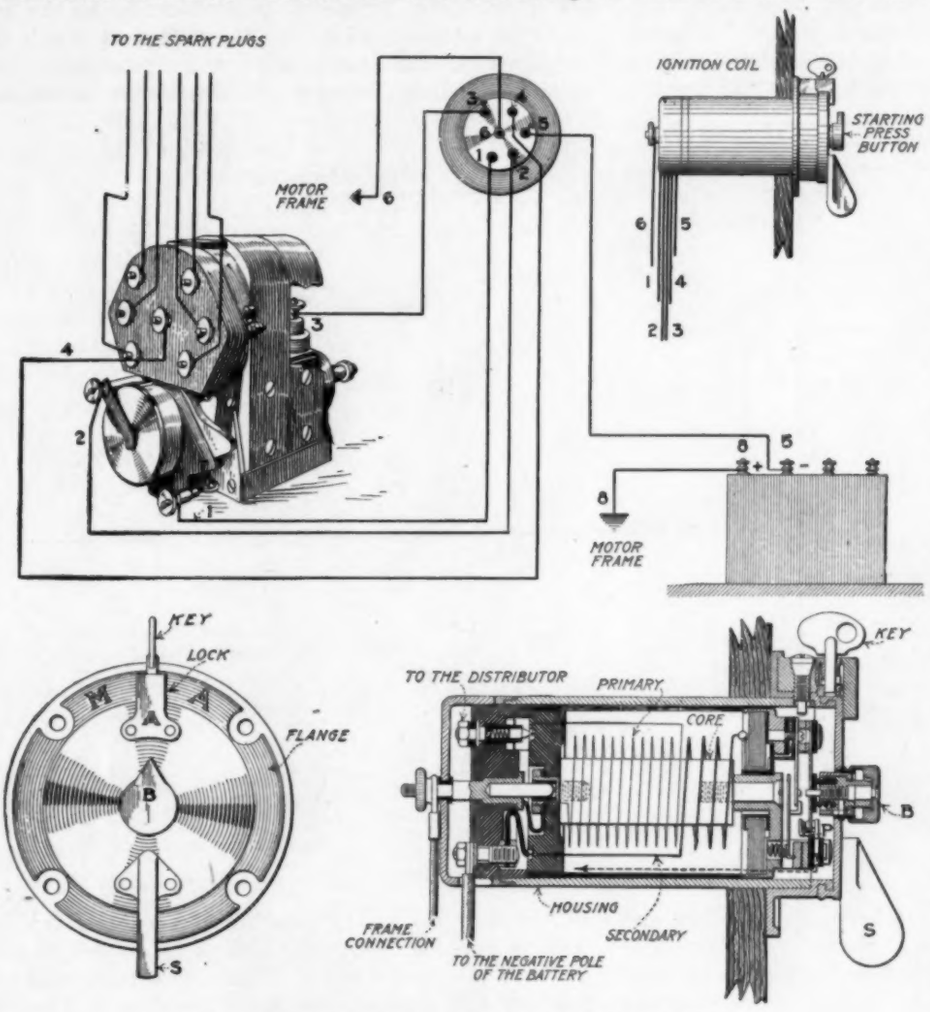


FIG. 9. WIRING DIAGRAM OF BOSCH DUAL IGNITION

should be fully retarded before switching on, for there is a chance that the piston might have come to rest just before the top of the compression stroke, in which position with an advanced spark, the engine would be reversed and back-firing might occur. If the engine is started by placing the switch *S* at *A* the motor will run on battery ignition, but with the vibrator out of circuit, the button *B* having been relieved of pressure. For interrupting the current the circuit breaker on the magneto is used and so the coil is acting as a non-vibrating coil. By placing the switch *S* at *M* the motor will run on magneto ignition and the battery current will be switched out.

In the wiring diagram of this system it will be noticed that while the independent magneto requires but one switch wire in addition to the cables between the distributors and sparkplugs the dual system requires four connections for the same. Two of these are high-tension wires and consist of wire No. 3 by which the high-tension current from the magneto is led to the switch contact and wire No. 4 by which the secondary current from either magneto or coil goes to the distributor. Wire No. 1 is low tension and conducts the battery current from the primary to the circuit breaker on the magneto. Wire No. 2 is a ground wire by which the primary circuit of the magneto is grounded when the switch is thrown to the off, or battery, position. Wire No. 5 connects the coil with the battery. Wires No. 6 and No. 7 are ground wires for the coil and the battery. As airplane motors are built for high speed, a two-point dual ignition system, shown in Fig. 10, is generally used. The necessity of this system is based on the fact that the combustion of the explosive charge in the engine cylinders is not an instantaneous affair but requires an appreciable interval of time, depending upon the size of the combustion chamber, the quality of mixture and the nature of the fuel. The securing of the maximum amount of work from the fuel requires that the explosion should occur in the shortest possible time, so that it shall be completed at the end of the compression. This explosion time is successfully reduced to the minimum with the two-point ignition system in which each cylinder is provided with two sparkplugs. The wiring diagram is the same as the wiring diagram of the dual system (except for the distribution) and the current is distributed to the sparkplugs with a double-acting distributor. As the magneto delivers a certain number of sparks at each revolution of the armature it is necessary to have a speed ratio between the crankshaft, armature and distributor that can be varied according to the number of cylinders in the engine. For this purpose the magnetos are constructed to give either two or four sparks at each revolution of the armature. For a four-cylinder, four-stroke engine the magneto delivers two sparks at each revolution, the armature revolving at the crankshaft speed while the distributor speed is half of the armature speed. For a six-cylinder, four-stroke engine the magneto delivers two sparks at each revolution, the armature revolving 1.5 times the crankshaft speed and the distributor at one-third the armature speed. For 8 and 12 cylinder motors a four-spark magneto or two two-spark magnetos are used. If the magneto delivers four sparks at each revolution in an eight-cylinder, four-stroke motor the armature must

revolve at crankshaft speed and the distributor (having eight segments) at half armature speed.

It is necessary to note here that in a magneto delivering four sparks at each revolution the armature core is provided with four poles—two north and two south—thus changing the direction of the current through the coil four times per revolution. Naturally, the circuit breaker on the four-spark magneto has to break the current four times in each revolution, and for this purpose it must have either four raised segments in the cover or a four-point cam. For a 12-cylinder, four-stroke motor, when the magneto delivers four sparks the armature revolves 1.5 crankshaft speed.

magnetos should be controlled by one advance lever and no backlash should be present in the connections between the lever and the magnetos.

The magneto is usually installed on an aluminum base, but never on an iron or steel base because this would deflect some of the magnetic lines from the armature and weaken the current. To adjust the armature position to the piston position with the magneto shaft disconnected, turn the engine shaft until the piston of the cylinder No. 1 reaches its dead center at the end of its compression. This is the position at which the spark should take place when fully retarded. Now remove the circuit breaker and distributor covers and

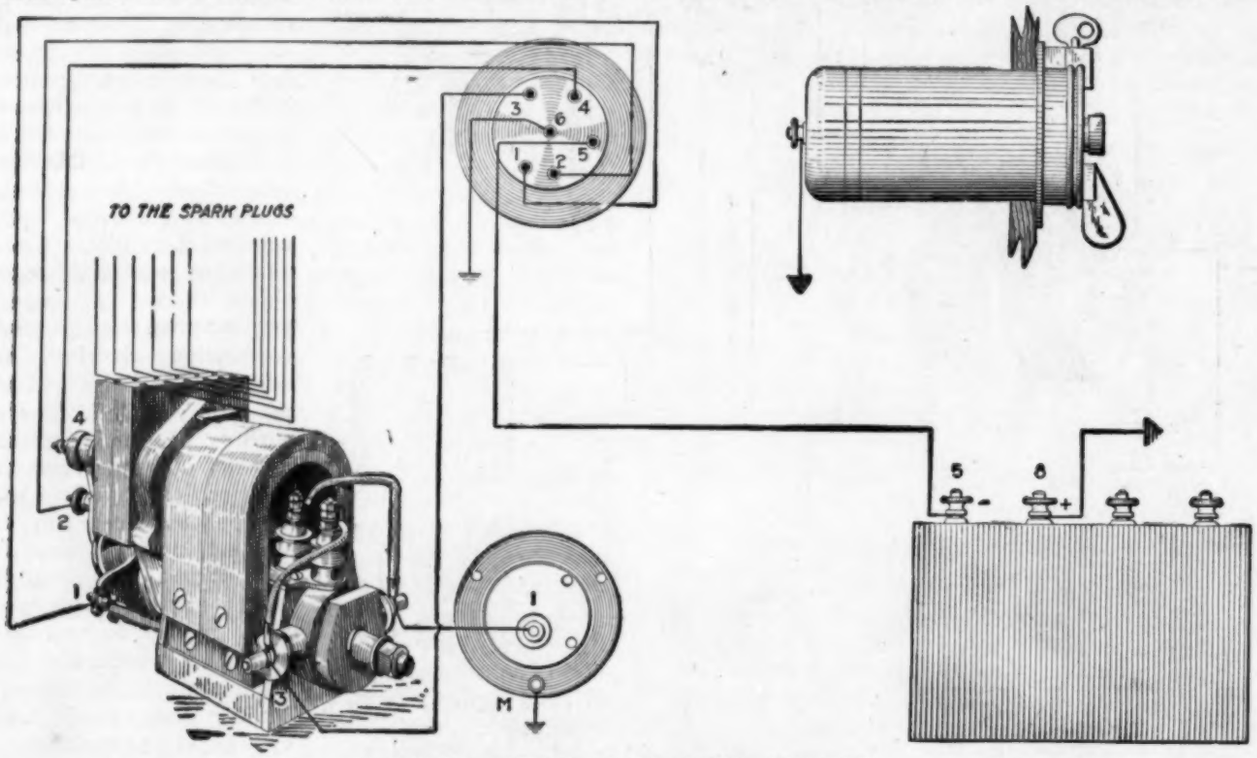


FIG. 10. BOSCH TWO-POINT DUAL IGNITION

In order to distribute the sparks to 12 cylinders and yet maintain a safe distance between the distributor segments, the distributor is composed of two six-cylinder motor distributors placed side by side; a double-armed rotor is used and the contacts are so arranged that one segment in each is alternately in contact. The distributor then revolves with one-third of the armature speed. So long as a multicylinder airplane motor does not run at a greater speed than 1200 to 1500 r.p.m. it is satisfactory to use a two-spark magneto running at twice the crankshaft speed.

With a speed greater than 1500 r.p.m. the armature speed would be over 3000 r.p.m., and such a speed would overtax the strength and durability of most magneto circuit breakers, so that the wear would soon become excessive. It is advisable, therefore, to use two magnetos for a multicylinder motor. For an eight-cylinder motor two four-cylinder magnetos, and for a 12-cylinder motor two six-cylinder magnetos. To obtain the maximum horsepower with such ignition it is necessary that both circuit breakers be carefully timed, otherwise the time intervals between the sparks from the two machines will be unequal. Further the advance arms of both

set the magneto so that the breaker contacts are just opening and the distributor arm is in connection with the wire to cylinder No. 1. Hold the armature in this position and connect the drive coupling. Then do the same thing with the remaining cylinders. This gives the maximum possible spark advance and gives a retarded spark at the dead center.

The most delicate part of the airplane magneto is the circuit breaker. In the case of a 12-cylinder, four-stroke motor, where the magneto is geared at 1.5 times crankshaft speed, the friction and pounding to which the various components of the circuit breaker are subjected are enormous, since with an engine speed of 3000 r.p.m. the magneto armature is revolving at 4500 r.p.m. This means that the four-lobed cam on the armature shaft strikes the fiber of the pivoted breaker bar 300 times a second. It is natural that by this quick action wear of the contact point will be great and damage to other parts of the circuit breaker will be likely; therefore it is advisable from time to time to inspect the circuit-breaker points. If any wear takes place a readjusting or changing of the contact points is necessary. The same should apply to the distributor.

It will be necessary to remove the carbon dust caused by the wearing of the carbon contacts from time to time with a soft, clean cloth or to wash them with gasoline. After washing, lubricate the distributor with a very thin film of oil.

To ignite the charge in the motor cylinders all ignition systems use sparkplugs, a sectional view of which is shown in Fig. 11. In a metal shell, which is threaded to screw into a hole in the cylinder wall and which carries one or two electrode points at its inner end, is placed a central electrode of wire in an insulator, usually of porcelain or mica. One end of the secondary circuit is fastened to the binding post of the plug, which is connected to the insulated-wire electrode. The other end of the secondary is grounded to the frame of the motor. Since the central wire of the plug is insulated from the shell, the only course for the current is to jump from the end of the central electrode to the fixed electrodes on the body of the plug and thus complete its path through the metal of the engine. The most important elements in the sparkplugs are the insulator and the electrode. The insulator is made from mica and porcelain. The mica insulator is made up of thin sheets of mica either in the form of laminated washers or in the form of sheets wound around a central spindle. The insulation has to be wound very carefully because if there is any space between the mica layers the plug will short-circuit in a very short time on account of the accumulation of oil between the layers. A few drops of oil on a sheet of mica will change it from insulator to a conductor.

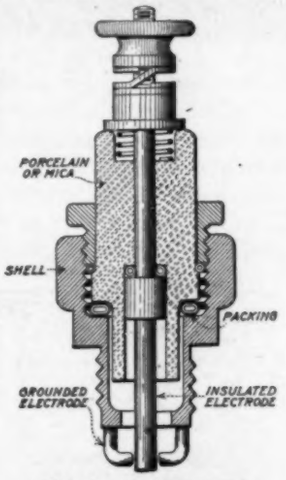


FIG. 11. SPARKPLUG CONSTRUCTION

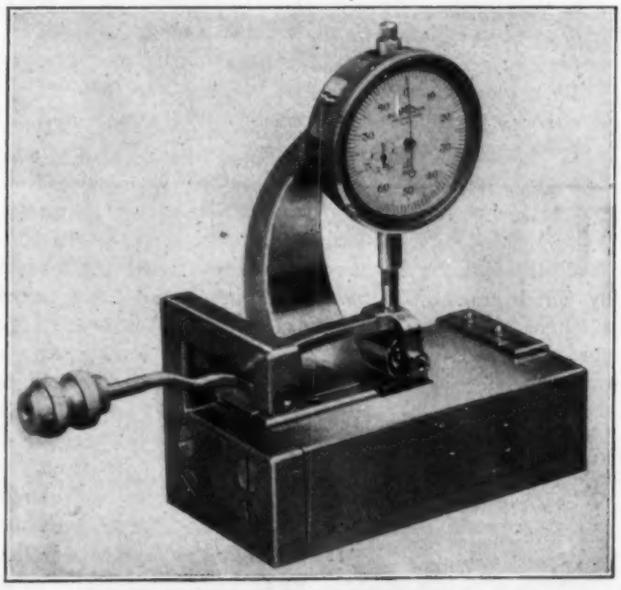
The porcelain insulators are of special clay product made strong mechanically to prevent any crack during service. A large percentage of porcelain breakage is due to the careless handling of wrenches, but breakage in service is caused mostly from the porcelain not being able to stand the terrific heat shocks occurring in the combustion chambers of the motor. The temperature jumps almost 900 deg. F. when a cool motor is started, and because the porcelain is a very poor heat conductor it is not likely that it will last long without any cracking. It is advisable to occasionally inspect the porcelain as there is a certain temperature at which the porcelain becomes a conductor.

The electrode wire must be a good conductor of heat and current. It should not expand much or it will split the porcelain or mica. This means that an ideal conductor should have the same coefficient of expansion as the porcelain. The material of most sparkplugs elctrodes is nickel manganese. It is necessary that the sparkplug should be gas tight because a continuous passage of the hot gases through or between the porcelain and shell will make it a conductor. A good, serviceable plug will not short-circuit, leak or break down. A short-circuit is mostly caused by a deposit of carbon on the porcelain or mica element either resulting from too rich a mixture or too much lubricating oil, or both. It is important to inspect the sparkplugs and handle them carefully when removing the carbon deposit.

The gap between the central electrode and the electrode mounted on the body should not be too big. The normal gap is 0.4 to 0.6 mm. (0.015 to 0.025 in.) between the electrodes. This sparking distance should not be adjusted when the sparkplug is removed from the cylinder because the spark jumps a much greater distance in the open air than in the combustion chamber when under the pressure of the gases. A sparkplug can be tested by making connection with a screwdriver between the binding post of the sparkplug and any metal part of the motor. If there is continuous sparking between the screwdriver and the metal of the motor the sparkplug is working in perfect order.

Gage for Measuring Thickness of Strips

A new application of the dial gage is shown in the illustration, this being for the continuous measurement of the thickness of the suture material used in sewing up wounds. While the gage was originally designed for



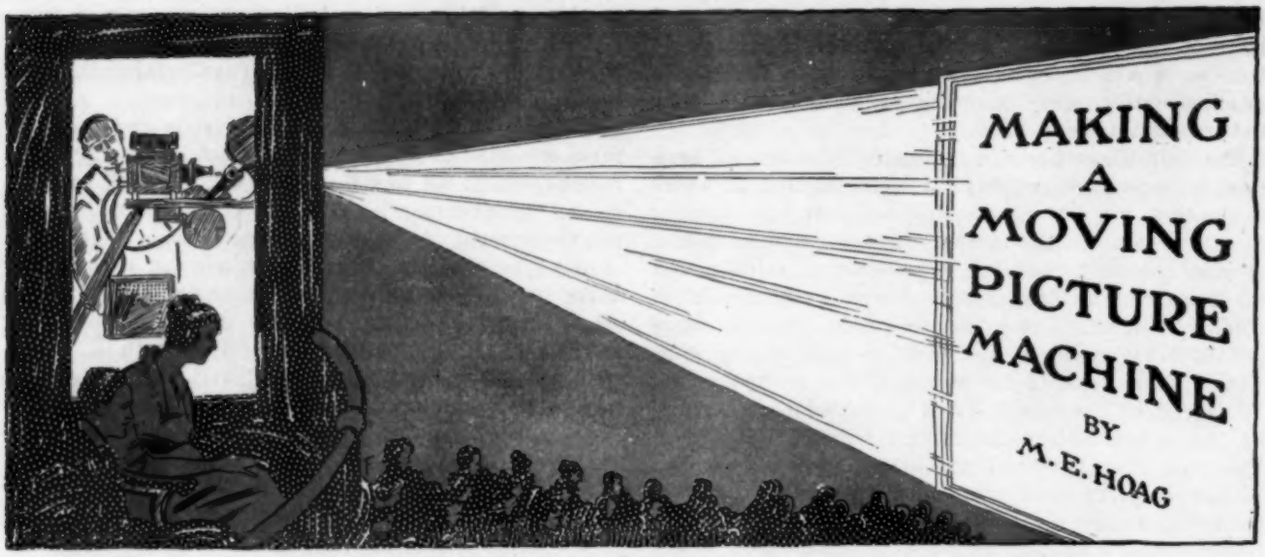
GAGE FOR MEASURING THICKNESS OF STRIPS

the Field Medical Supply Depot for this particular work it is now being used for many purposes.

The material to be tested is passed under the roller that supports the spindle of an Ames dial indicator as shown. It passes with a continuous motion and it can be easily noticed when any portion of the passing materials varies from the standard thickness. This allows the bad spot to be easily marked so that they can be cut out, leaving only the perfect material.

This instrument, after being adjusted with Johansson blocks, has been found to be accurate within less than 0.0004 in., so that variations in thickness may be observed while the material is passing through the gage.

As first made two rollers were used, but these increased the probability of error, as any slight eccentricity in either roller might be multiplied. The instrument was made by the Bureau of Standards.



MAKING A MOVING PICTURE MACHINE

BY M. E. HOAG

II. Making the Machine Frame

The preceding article dealt with the application of the motion-picture machine to factory and sales organizations and to the optical and mechanical features involved in the production of pictures. This article will describe the manufacture of various parts of the machine and the dies and tools used in their production.

THE largest single part of the Victor Animatograph is the cast-aluminum frame shown in Fig. 4. This frame has a number of hubs and bosses by which many of the working parts are located, some of them turning on screw studs while others are supported on shafts which rotate in bronze bushings.

As the accurate spacing of many of these parts is very important, an accurate drilling and reaming jig is required. The jig used for these operations is shown in Figs. 5 and 6. Before drilling, the frame is milled at certain points, the most important one being the surface at *A*, Fig. 4, it being from this surface that the other parts are located. The frame is placed in the jig, as shown in Fig. 5, the edge of the web being slipped under the four clamps *A*. The knurled wheel *B* is then turned, drawing the two locating buttons *C* into the corners of the milled portion shown at *A*, Fig. 4, the double-link clamp *D* equalizing any variations due to warping or shrinkage in the casting. After these buttons are adjusted the screws in the four clamps *A* Fig. 5, are tightened to hold the frame in position. The jig cover shown in Fig. 6 is then placed on the frame, being located by the four studs *A*, which enter corresponding holes in the base of the jig. This jig is rather novel in construction, inasmuch as it is built up entirely of standard sections of cold-rolled steel, which greatly lightens its weight and also allows for additions or for changes if found desirable.

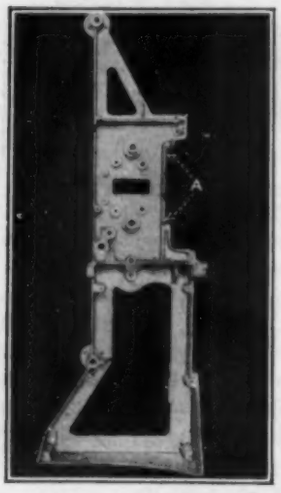
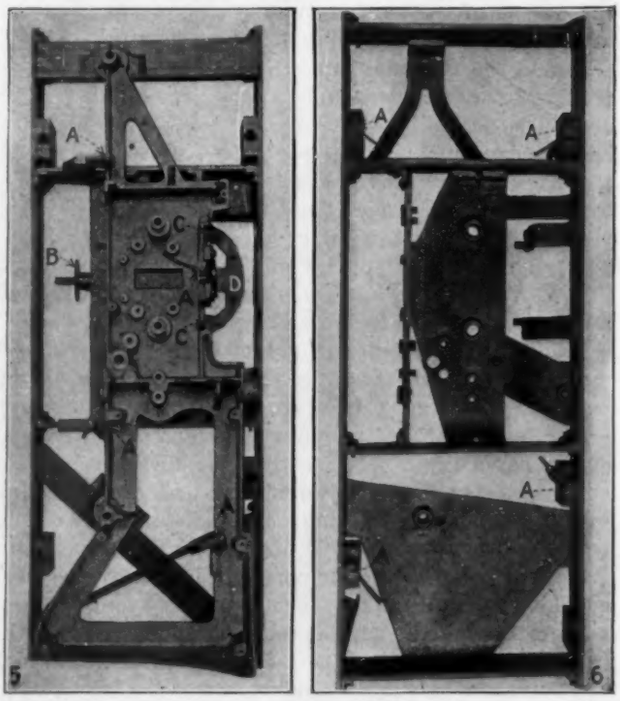


FIG. 4. FRAME OF THE MACHINE

In the first article reference was made to the modified form of Geneva gear used to secure the required in-



FIGS. 5 AND 6. THE JIG FOR DRILLING THE FRAME
Fig. 5—The jig. Fig. 6—The jig cover

termittent movement of the film. The driving member of this gearing is shown in Figs. 7 and 8, and the driven member in Fig. 9. An end view of this member is also shown in Figs. 10 and 11. Reference to the drawing, Fig. 8, will show in detail the construction of the driver. As these pieces must be accurate they are made on the lathe and the pinion pressed in after completion. The opening inside of the rim *A*, Fig. 7, being only for clearance and to lighten the part, great accuracy is not

required; therefore it is cut out with a hollow mill. The hole for the pin *B* is drilled and reamed in a jig and the corresponding opening in the rim *A* is cut out with a counterbore, after which the pin *B* is pressed in and the flat milled.

The driven member is made in two pieces, the head being pressed onto the shaft, the opposite end of which

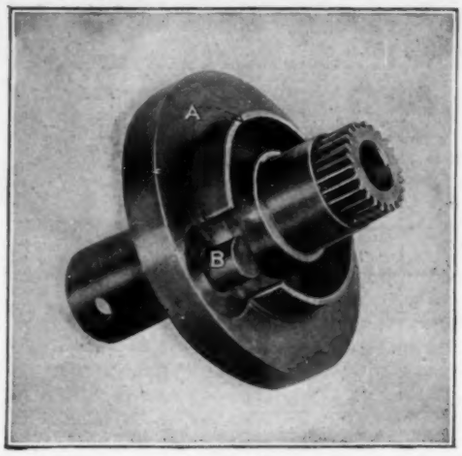


FIG. 7. THE DRIVING MEMBER OF THE INTERMITTENT GEAR

receives the sprocket that drives the film. When assembling the head and shaft the latter is not pressed clear through, so that it leaves part of the drilled hole free. This is used as clearance for the milling cutters when milling the three radial slots which are well

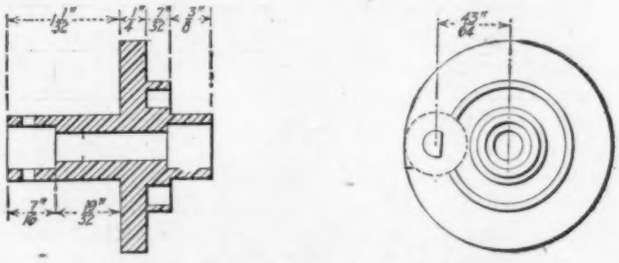


FIG. 8. DETAIL OF DRIVING MEMBER

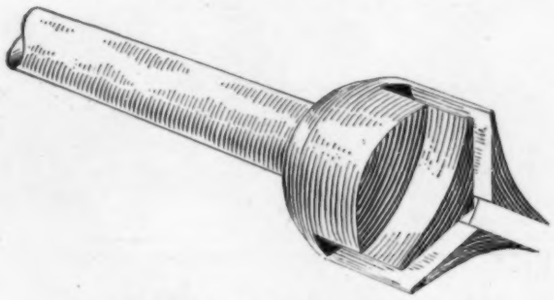
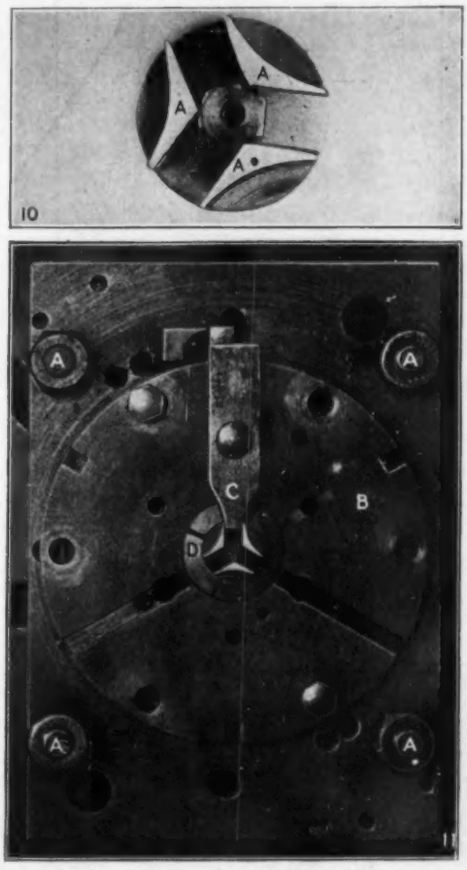


FIG. 9. THE DRIVEN MEMBER OF THE INTERMITTENT GEAR

shown in Fig. 10. The next operation is that of cutting away the metal as shown at *A*, which is done on an engine lathe in the jig shown in Fig. 11. This jig consists of a top and bottom plate and four posts, *A*. The bottom plate is doweled firmly to the lathe faceplate to locate the jig correctly. The top plate is a movable member *B*, which may be changed to meet the requirements of the various styles of gears. The hardened finger *C*, which acts as a locating device for the work, has a rib on its lower side which fits a slot in the plate *B*. The spring collet *D* holds the work so that it may be readily released and indexed for the remaining cuts. The finishing at this point is done on a bench lathe with a grinding wheel, care being taken to have the wheel either exactly to size or slightly under size, for if the radius of the wheel is greater than the diameter of the rim of the driving member, the bearing at this point will be at the center, instead of being distributed over the full length of the arc, and thus will allow the driven shaft to rock or vibrate while the driver is passing through this portion of the cycle. This vibration will then be transmitted to the film and so ruin the value of the picture. This movement allows the film a rest period in proportion to the period of motion of six to



FIGS. 10 AND 11. THE STAR WHEEL AND JIG FOR MACHINING IT

Fig. 10—End view of starwheel or driven member. Fig. 11—Jig for machining the starwheel

one, which allows a large amount of light to pass and so adds to the brilliancy of the picture. This gear movement runs in an oil bath which insures long life and smooth action.

The standard width of the film and the size and spacing of film perforations adopted by the Society of Motion Picture Engineers are shown in Fig. 12. As the smoothness of the projected picture depends to a great extent on the accurate meshing of these perforations with the driving sprocket shown in Figs. 13 and 15 considerable care is required in making the sprocket not only as to the exact size and spacing of the sprocket teeth, but that it runs perfectly true as well. These sprockets are first roughed out as shown at *A*, Fig. 13.

Then with the tool shown in Fig. 14 the rims for the teeth are turned true to size and spacing.

In cutting the teeth the sprocket is placed on a mandrel in the dividing head and a formed cutter which is centered over the rim that forms the teeth is made

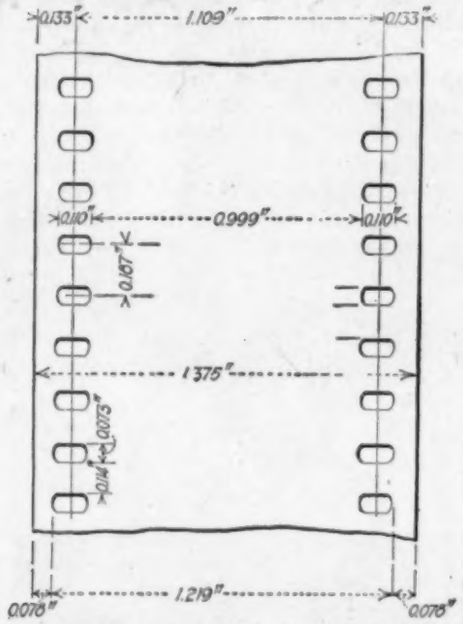


FIG. 12. STANDARDS FOR FILM PERFORATIONS

to cut straight down into the work. The forming cutter is shaped to cut the tooth space the same as a gear cutter, but instead of the face being straight across it is concaved with a radius equal to one-half the root diameter of the sprocket. It is thus possible to cut a very slight clearance between the teeth and not interfere with the smoothness of the rest of the piece.

This is necessary, otherwise the film will sag and buckle on account of not being well supported.

Another set of sprockets used in the machine is made up in a novel manner, the toothed parts shown in Fig. 15 being made of steel and assembled in a die-casting mold where the molten metal is cast around them, binding them together as shown in Fig. 16.

A Chart of Helix Angles

BY ARTHUR B. BABBITT

To determine quickly the helix angle of a worm thread, having given the diameter and lead of the worm, the following chart will be found useful. The chart may

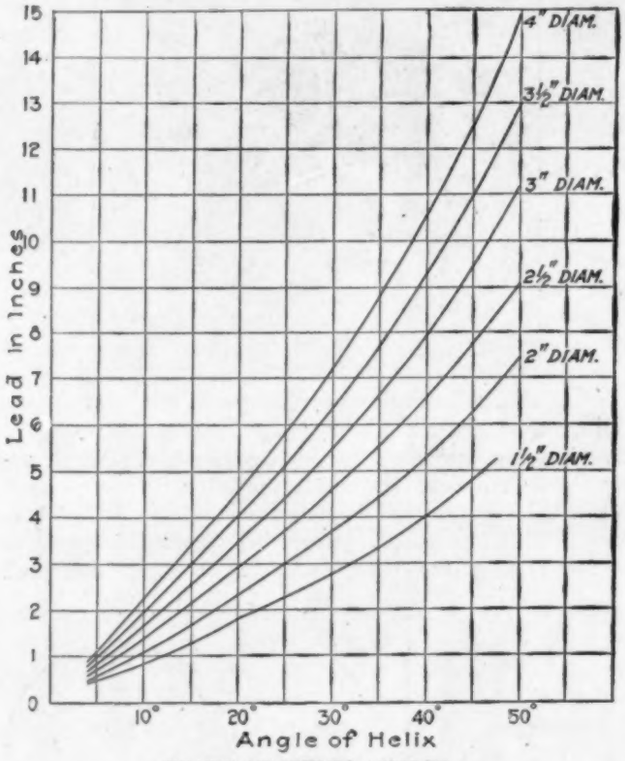
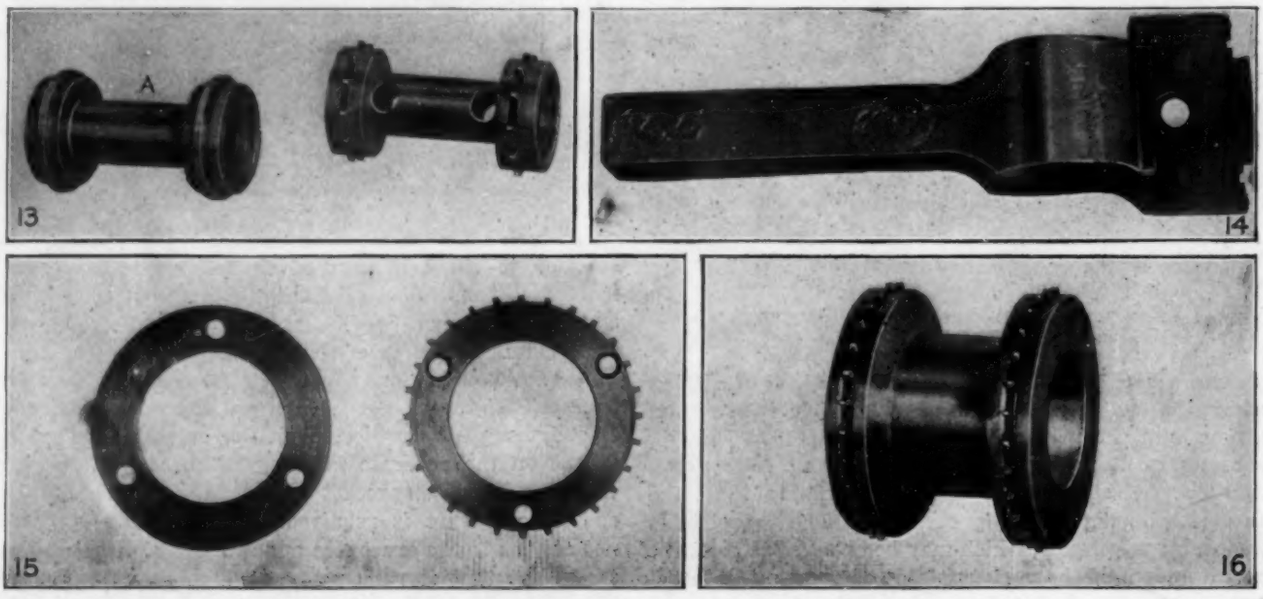


CHART OF HELIX ANGLES

also be used in the reverse manner to determine the lead to be used for different diameters when a certain angle of helix is required.



FIGS. 13 TO 16. SPROCKETS AND TOOL FOR CUTTING THEM

SOLVING NEW HAVEN'S MAN-POWER PROBLEM

By

Charlton L. Edholm

EXECUTIVE SECRETARY OF THE COMMITTEE ON MAN-POWER ENGINEERING, NATIONAL AMERICANIZATION COMMITTEE

This article shows how engineering methods were used to tap new sources of local supply and how by organized publicity they attracted 247 women a week, or 53 per cent. increase, to the war factories of New Haven.

APPEALS to the American spirit of the citizens of New Haven, Conn., proved successful in increasing the supply of war workers after engineering analysis of the situation had shown that the only unexhausted source of new labor was to be found among residents who could change their occupation or put forth extra efforts in addition to discharging home duties to increase the country's supply of munitions. The immediate response increased the weekly supply of new women workers first by 50 per cent., then by 100 per cent.

When the draft threatened to deplete their factories the men who direct the big plants of New Haven canvassed the various sources of labor supply and found that there were six, namely: (1) To transfer workers from an essential industry in another community, or (2) from the same community; (3) to transfer from a nonessential industry in another community or (4) from the same community; (5) the employment of idlers, who were designated "industrial slackers," and included the well-to-do shirkers as well as the vagrants, and (6) the development of latent industrial forces within the community.

It was recognized that the transfer of labor from one essential industry to another was merely working in a circle and could produce no good results. The transfer from nonessential industries was made difficult by the fact that in many cases it was impossible to determine what industries are nonessential. Some goods that are regarded as luxuries serve a valuable purpose when the question is analyzed, and luxuries designed for export are especially "essential" in maintaining a favorable trade balance by protecting the nation's gold reserve.

There remained the employment of the industrial slacker and the development of the latent forces within the community, and it was upon these sources that the employers decided to draw. A publicity campaign was undertaken through the newspapers and several meetings were held, some of them by women's clubs and some for the general public.

It was found by investigation among the women's clubs that a large number of girls and young women were available for certain kinds of work in the factories requiring quick wits and nimble fingers rather than muscular strength. Tending machines and feeding them with raw material, and inspecting, finishing and various processes could be handled by women as well, if not better, than by men. But the difficulty was to overcome the class prejudice that from time out of mind had kept women out of factories.

FIG. 1. INSPECTION—A LIGHT, EASY TASK FOR GIRLS

The patriotic appeal was brought out in newspaper advertising, and of the series of half-page displays that were carried the following is typical:

> TO THE WOMEN OF NEW HAVEN:
>
> New Haven needs your individual help for national service.
>
> The United States Government has called upon the manufacturers of New Haven to furnish immense quantities of a great variety of products. A large number of industrial workers are needed for this purpose.
>
> The industrial work of New Haven, which is clean, honorable and well paid, offers an opportunity for national service.
>
> The more people who work in a family, the less is the burden upon the individual. The more people who work in a community the better is the distribution of the burden of support.
>
> To decrease the number of the unproductive and increase the number of workers is a war measure that will both serve the Government and New Haven, offset the high cost of living and stimulate business in general.
>
> Many of the women in England and France who do not require their wages for support are investing their earnings in Government bonds or distributing them in war-time charities. New Haven is not far behind England in this respect. Already we have many women who are rendering unselfish service of this character. This is a double service, as they are not only giving their time to increasing production but they are devoting their earnings to charitable and patriotic purposes.
>
> Further information as to the opportunities to do industrial work can be obtained by applying to the Industrial Recruiting Station at 673 Chapel Street.
>
> THE EMPLOYERS OF NEW HAVEN.

The press coöperated with much free publicity, giving space to articles on the efforts made by French and English women to sustain their governments by work in the munition plants. Editorials were printed on the same subject. Through the women's clubs the seal of social approval was set upon this movement, and in New Haven it became the correct thing to engage in war work, including industrial employment. A centrally located bureau was established where volunteers could enroll for work in factories and women's organizations were canvassed to secure names. Thousands of women signified their desire to enter factories, either munition works or others.

Prior to the inauguration of this campaign the Winchester Repeating Arms Co. had been securing about 160 new women workers a week. During the first two weeks this average was increased 50 per cent., while for the first four weeks an increase of 100 per cent. was netted. From this point on the gain in their company's plant was less spectacular, dropping to an average of 54 per cent., more because the demand for workers had been filled than for lack of applicants. A large number applying to this plant and distributed to other war industries are not included in these figures.

The wages offered to women were the same as those offered men for similar work, and care was taken to protect the women factory workers from injury, excessive fatigue and undue discomfort. It was found that many women were available for only part-time work, so the plan was adopted of pairing, one woman agreeing to work in the forenoon and the other in the afternoon. This arrangement was sometimes extended to allow neighbors who "paired" to take over each other's home duties, so that while one woman was in the factory the other would look after the children and "keep an eye on the house" of the other.

In order to facilitate the patriotic impulse to work for the nation the Winchester Repeating Arms Co. issues service flags and bronze badges for the munition workers. The badge shows an American soldier charging, and in the background a huge munition plant, the work being artistically designed by George T. Brewster, a sculptor of distinction. Each Winchester employee

FIG. 2. WORKING COAT WORN BY WINCHESTER GIRLS

received a badge free. The service flag was issued to each employee and is designed for display in the window like the Red Cross service flag. It bears a reproduction of the badge, and the white field has space for stars, each representing a member of that household engaged in munition work. Both men and women wear the badges with pride, and the windows of New Haven are bright with the service flags, showing the fine spirit that animates the industrial workers who are helping win the war by their daily toil.

There are two chief reasons why the New Haven plan is superior to the old competitive method of bidding for labor from other cities. In the first place an influx of workers from the outside means a derangement of living conditions in the city. To secure 10,000 workers it would be necessary to absorb about 40,000 new inhabitants. The difficulty of obtaining housing

for that number is a staggering proolem in these war times, and the facilities of schools, street cars, railroads and other public services are taxed by the shifting of population.

The second reason is that the use of women in industry is certain to increase with a long war. The time to get women accustomed to the idea is now, for the overcoming of prejudice is a long, slow task. The addition of thousands of skilled workers to American industries is going to be a big help in winning the war, and as long as the women are given equal pay with men for the same service there is no injustice to labor in employing them.

Discretion must be used in placing the women workers at tasks that are not too strenuous. Hours of labor, working conditions, living conditions and wages should be adjusted to make the industrial work attractive, profitable and safe for the newcomers. If it is entered into in a spirit of greed and exploitation the employment of women will meet deserved opposition and will surely fail. If it is entered into in a spirit of genuine (not camouflage) patriotism it will be a mighty blow in the cause for which our soldiers are fighting.

The Modern Foreman—What Is His Present Job?

BY A. ELLSWORTH

Replying to the somewhat sorrowful comment by A. G. Stoehr (page 143) on my letter under the head of "The Modern Foreman—What Is His Present Job?" which was published on page 1089, Vol. 48, I wish to say that I had not the slightest intent to deprecate the skill and efficiency of the honest-to-goodness engineer, the necessity for and value of whose services I fully appreciate.

The party toward whom I directed my more or less withering sarcasm is the "guy" who, having acquired a somewhat superficial knowledge of the technical requirements, elevates himself or is elevated by some equally irresponsible person to the standing of an "engineer by education."

There are an everlasting lot of fellows whose knowledge having reached the dangerous stage stops short of teaching them that they are not what they think they are, and it is my belief that some of these men are by the very ignorance of their own incompetence clogging the wheels of production.

WHAT THE PUBLIC HEARS OF

It is an undeniable fact that in some of our governmental departments the machinery of production is functioning quietly, swiftly and efficiently, while in others it is more or less open to criticism. It is equally true that little or nothing is heard by the public of the former, though their efforts be of vital importance to the nation, while the failure or lagging of the latter is the subject of endless chafing and comment, in which the words "planning department," "efficiency department," etc., are frequently heard.

Can this be because the former departments do no planning?—have no efficiency system? Or is it because the men who do this work are *real* engineers, while their counterparts in other departments, though very sure of their professional status, have not yet pushed their knowledge beyond the danger point?

My idea of an engineer is a man who utilizes natural laws and forces to *get things done*. The tools of his trade (the kind of engineer I am talking about does not care a whoop whether you call it a trade or a profession) are the knowledge which he has tucked away in his head of the nature and extent of the forces at his command and the methods by which they can be subjugated to his will. It does not matter in the least whether he acquired these tools in a college, a correspondence school or a backwoods machine shop, either, both or all three, so long as he has them and is able to use them.

Mr. Stoehr's statement that "there is no question in the minds of factory men of even limited experience that the present-day method of engineering is at least 100 per cent. more efficient than that of 40 or even 20 years ago" depends very much on what is meant by engineering methods. If he means the tools and machinery of production there is no question—his statement is conservative; but if he means the skill and resources of the average "engineer," then the question does exist.

We who are familiar with shop conditions of the present day know that there is entirely too much interference between departments, many of which are not infrequently too reluctant to shoulder the responsibility of their own mistakes. One could hardly escape this conviction even though his only source of information were the daily newspapers, and certainly anyone who reads the *American Machinist* cannot fail to have the fact impressed upon him that in too many instances the very ones to whom we should look for harmony and system are quarreling among themselves and blaming everybody but themselves for lack of production.

EFFICIENCY ENGINEERS

The casual reader might be pardoned for taking newspaper talk along these lines with a grain of salt, but when this testimony is corroborated by personal knowledge one is apt to give it greater credence. Several cases have come under my observation where output has been hampered and cost of production increased, and in one at least of these cases the concern was systematized into bankruptcy by a corps of "efficiency engineers."

Cases of this kind are (let us hope) in the minority, but like a sore thumb they assume a prominence entirely out of proportion to their importance. It was to deal with such cases that in a former letter I advocated putting the departments in charge of one of the old-time foremen and giving him a "big stick."

I am not especially advocating the running of a factory organization by the methods of 40 years ago, though if Mr. Stoehr will investigate he will find more than a few successful ones that are being run that way, but I would have the "planning," the "tooling," the "systematizing," etc., done by men who are under the direct supervision of an engineer whose education is as "broad," whose experience is as "practical" and whose authority is as unquestioned as was that of the old-time foreman (who probably didn't know he was an engineer) who might have been a little short on differential calculus but was long on human nature and knowledge of applied mechanics.

New Railroad Shops in Chile

By V. A. Clarke

The Chilean State Railways is constructing at San Bernardo (a town about 10 miles from Santiago) a new locomotive shop, which when completed will be the largest industry of its kind in South America, and it is said of the main, or locomotive, shop that this will be the largest concrete building in the world.

Considered as a whole it is an undertaking of stupendous magnitude, and the chief engineer, Señor Rafael Edwards, and his associates are to be commended for the remarkable work they are bringing to a successful completion, especially as they have not at their disposition many of the modern appliances that engineers and contractors in the States have.

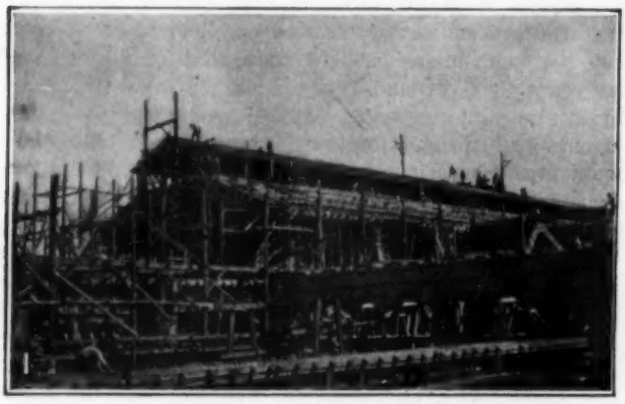


FIG. 1. THE LOCOMOTIVE SHOP PARTLY FINISHED

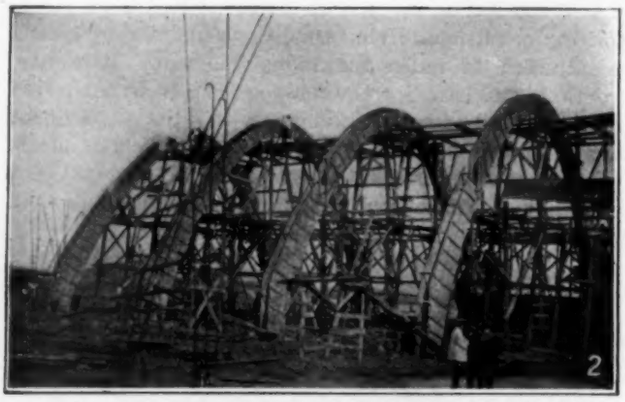


FIG. 2. PLACING THE FORMS FOR THE FORGE SHOP

FIG. 3. SHOWING CONSTRUCTION OF ROOF

FIG. 4. A NAVE IN THE LOCOMOTIVE SHOP

A brick wall surrounds an irregular piece of land of sufficient size to give ample room for pattern, foundry, forge, boiler, locomotive and car shops, and also minor buildings, such as power house, offices, storehouse, etc.

The locomotive shop is about 617 ft. long by 285 ft. wide and is of reinforced-concrete construction, and absolutely fire-proof. The saw-toothed roof is covered with a standard roofing material; the sash is of angle iron with welded joints, and has a southern exposure so that an abundance of light is assured.

This building is divided into five naves or bays. The ones on the sides and immediately adjoining the east and west walls will be entirely for constructing and repairing locomotives. To facilitate this work 38 pits will be constructed.

These bays will be served by two traveling cranes, each of 120 tons capacity, the rails of which will be about 40 ft. above the floor, and one of 10 tons with a rail height of about 28 feet.

In the adjoining bays will be installed the large machine tools, and these will each be served with a 15-ton crane, while the center bay will contain the smaller machines and a 5-ton crane.

The traveling cranes over the pits will operate the entire length of the building, while the ones in the bays between will stop at a sufficient distance from the southern end to admit the operation of a transverse traveling crane. This, with the installation of two turntables of 160 tons capacity each and a system of tracks, will permit the transfer of locomotives, cars and materials with every facility.

While these divisions are termed naves, or bays, there will be no visible division, or partition, to exclude light; the machine tools are to be arranged in groups so that routeing of work may be accomplished with the utmost efficiency, and all will be individual motor drive.

In the original plans provisions are made for enough machinery of a particular class to carry on the work of the construction of locomotives on a large scale, and although at the present time there will only be installed a sufficient equipment to do the major part of the repairing for the State Railways, the original plan will be adhered to and in many instances foundations will be constructed for machines to be installed in the future.

All the machine tools are manufactured in the United States and are furnished by the Niles-Bement-Pond Co., New York.

Some Long Island Windmills

By Edward P. Buffet

On the southern tail prong of fish-shaped Long Island which stretches 120 miles into the Atlantic remain about a dozen primitive grist windmills of a century old and upward. That region was colonized by the Puritans at the beginning of the settlement of New England, and probably they brought their structural ideas from Great Britain.

IN COLLECTING the material from which the selections for this article are made, numerous photographs were taken in the cramped, dark interiors of seven of these mills and outside views of others. The oldest of them, shown at the head of the page, is the windmill of Thomas Gardiner at East Hampton, built in 1771 or earlier. Fig. 1 depicts the mill of Maltbie G. Rose at Hay Ground, which was the only one commercially operated in the summer of 1917.

Figs. 5 to 10 inclusive show the inside mechanism of the following windmills: The Hay Ground; G. H. Buek's, at East Hampton; Osborne, Hand & Co.'s, at Wainscott; Edward P. Morse's, at Water Mill, and Miss Cornelia Horsford's, on Shelter Island, a satellite of Long Island. In order to encourage the local granger industry Miss Horsford had this mill renovated by its aged former miller, M. T. Griffing.

Modern engineers, basing their opinions of such frivolous testimony as experimental data, have sought to prove that windmills are prime movers of only moderate power. But if anyone wishes to be convinced that figures lie, he has simply to observe what happens when Mr. Rose hoists the canvas on his yardarms and releases the brake. It seems incredible that the friction of this huge, clumsy wooden mechanism can be so overcome as to let it move under any power whatever without racking the mill to pieces. Yet a light breeze against a few yards of cloth suffices to turn the mill and some have even been known to revolve by the pressure of the wind on their bare slats.

In a full gale, says Mr. Hand, of Wainscott, a windmill is supposed to yield 50 hp. One disadvantage in windmills was caused by the variation of direction of the wind, but this has been greatly overcome by the installation of an automatically worked director wheel. The woodwork of the mills is largely oak, white oak especially being popular; the wheel cogs are hickory, as also the brake strip. Buhr stones for grinding flour were quarried in France, but more or less satisfactory substitutes have been found in the United States, for instance in the South. The French stones were of comparatively recent introduction, and were imported in sections and put together with plaster of paris and bound with iron hoops. A local source of supply in the region of the Long Island mills was a place called Millstone. It is evident that the stones derived from there must have been cut from boulders, since nowhere on Long Island, except near New York, is there any bed rock, the land being of drift dropped by the Great Glacier, the terminal moraine of which forms the island's backbone.

FIG. 1. THE OLD MILL AT HAY GROUND

The pecking, picking or refinishing of millstones wore them more than did the grinding. Mr. Griffing stated that French buhr stones were worth $130 a pair and weighed 2200 lb. (each, presumably), and were balanced with lead. To be effective they had to run at 120 r.p.m., but it was not safe for a 4-ft. 4-in. stone to exceed this speed, though if it were 6 in. narrower it might run at 300 r.p.m. From another source I learned that the usual sail speed was 12 to 16 r.p.m. The gearing gave a movement of the stones four or five times as rapid as of the sails. Near the Gardiner mill lies an old stone which burst at 160 r.p.m. Ten bushels an hour, said Mr. Griffing, constituted good work. He exhibited the little old rectangular box used for measuring out the miller's toll. "The millers are mighty hard on us," wailed the complainant in one anecdote. "They take a tenth already; pretty soon they will be robbing us of a twentieth."

Owing to the cramped space in windmill lofts the photographs are rather fargmentary; hence in fitting them to their proper places it will be helpful to have before us a general diagram of the millwork. Fig. 2, showing an ideal section in elevation, has been drawn after comparing the different mills, and it depicts the most important of the gear trains in something like their proper forms and proportions, although without absolute dimensions. The typical mill may be taken as being 35 to 40 ft. high. Here are reproduced two old plates illustrating European methods. Fig. 3 is a Dutch gristmill of tower type, with revolving head, which belongs to the same class as the existing Long Island mills. It is taken from Johannis van Zyl's "Theatrum Machinarum Universale of Groot Algemeen Moolen-Boek," Amsterdam, 1761. Fig. 4 represents a post mill, a form wherein the main building containing the machinery is pivoted on a post, and which was followed more especially outside of Holland. Such a design was adapted to sawmill construction on Long Island. The drawing is taken from the "Recueil de Planches sur les Sciences et les Arts," Paris, 1762.

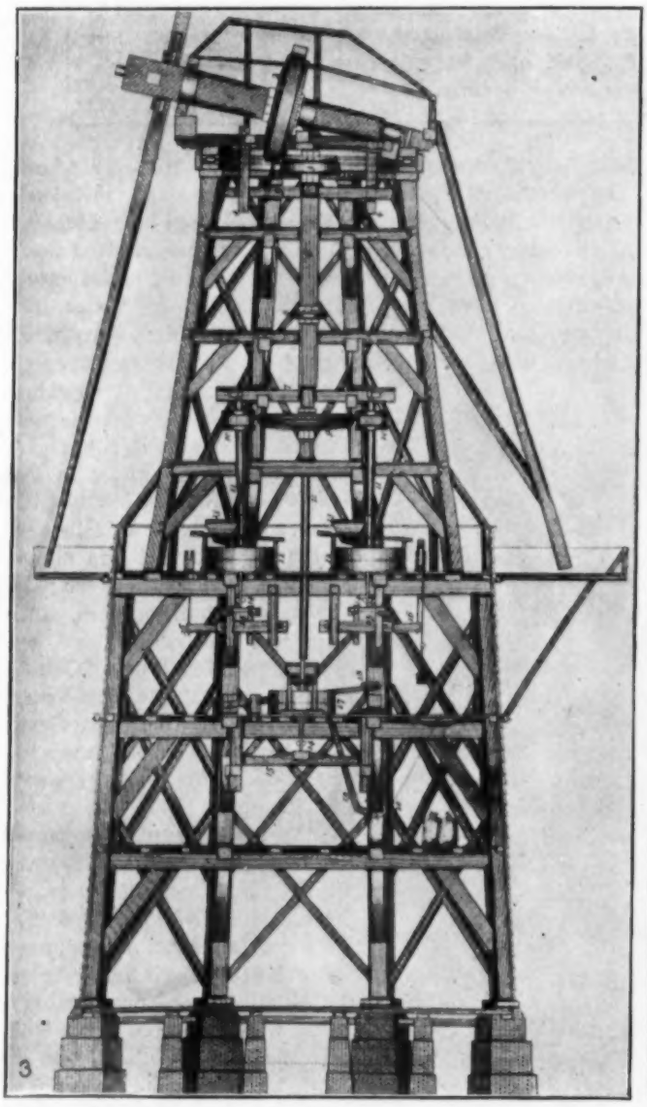


FIG. 3. DUTCH GRIST WINDMILL

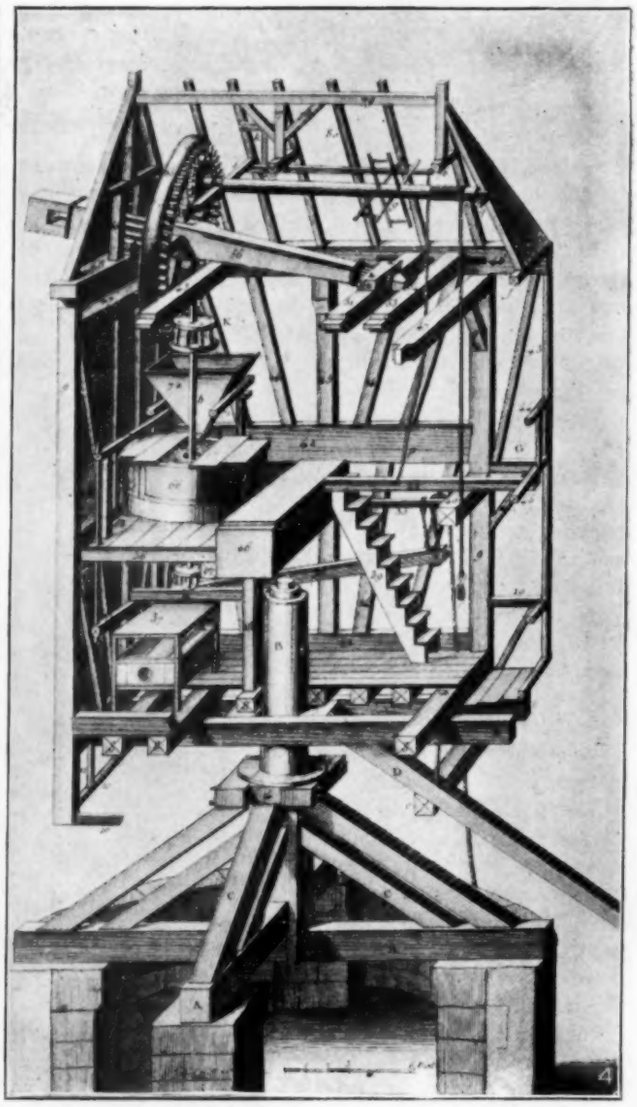


FIG. 4. FRENCH GRISTMILL, POST TYPE

Each of the present Long Island mills is octagonal and contains three stories, the two flights of stairs generally being arranged to suggest the winding steps of a lighthouse. The arms which carry the latticework for the adjustably outspread canvas are mortised through the thick wooden shaft, each pair in a different plane for obvious structural reasons. The entire head, or dome, carrying this shaft revolves on iron rollers and is held central by inside horizontal ones. There are three ways of turning the head; the primitive one is to twist it by a timber tail reaching to the ground and supported by a cart wheel. Cape Cod mills still retain this device, which in the main agrees with that made familiar to us by Dutch pictures. A Rembrandt etching, for example, shows a tail of braced construction with a rope tackle at the lower end for pulling it around or fastening it.

While this system was once in vogue among the Long Island Hamptons it has now been generally superseded by two others. According to each of these the inside of the head near the roll track is provided with a circular rack *A*, Fig. 5. Sometimes this rack has wooden cogs and is driven by a pinion on a shaft reaching down to the lowest story, where, directly under

the ceiling, it is geared to another shaft turned by a hand lever. On a Block Island mill the rack and pinion were outside of the head.

With the third and most highly improved system, automatic rotation of the head is produced by a small auxiliary windwheel on an outrigger opposite the main wings. This pilot wheel, the director, is in a plane at right angles to that of the large one, so that when the latter is correctly pointed the little one stands edgewise to the breeze. When the wind veers it turns in one direction or the other and brings the head back into its true position. The transmission adopted by Long Island millwrights contains a worm between the director and the head, and the driving pinion is of iron; presumably the circular rack also is of iron, though it

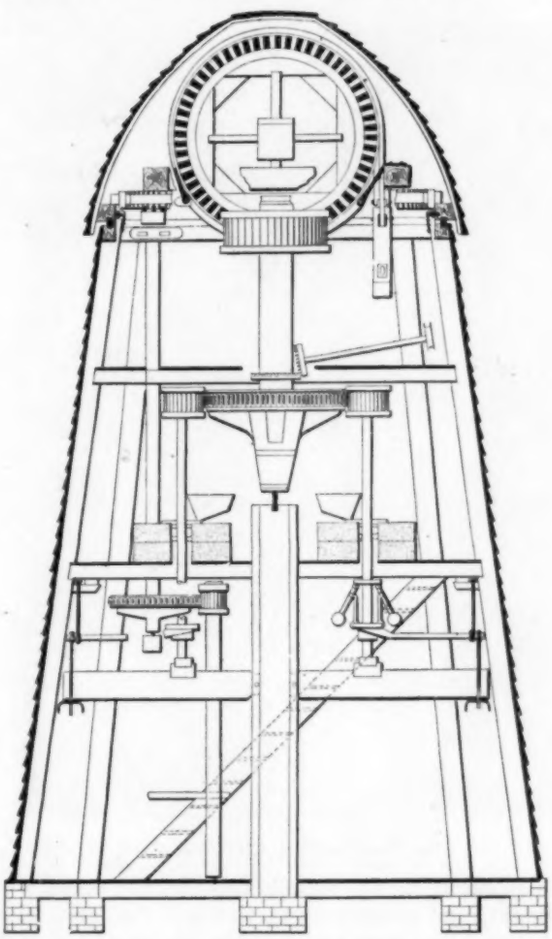


FIG. 2. SECTION OF TYPICAL LONG ISLAND WINDMILL

is concealed between collar timbers. Fig. 6, looking out from an upper window of the Wainscott mill, gives some details of the orienting mechanism, which are admirably clear despite their bad repair. The director wheel on the Hay Ground structure, as on others, is an alteration. The venerable Mr. Rogers, who lives near it, remembers that his office when a boy was to revolve the head by one of the archaic tail timbers.

The massive wind shaft, slightly inclined to the horizontal, is square hewn from an oak tree. The one in Mr. Morse's ruined windmill at Water Mill is built up of four rough logs bolted together with short filling pieces at the journal, but this may be only a makeshift, thrust through the loose and toppling driving gear to support the wings. The pillow block is generally wooden, but here it is of iron and, for that small mill, is cast to receive a shaft about 20 in. in diameter. The wooden bearings were more or less lined with iron. On Cape

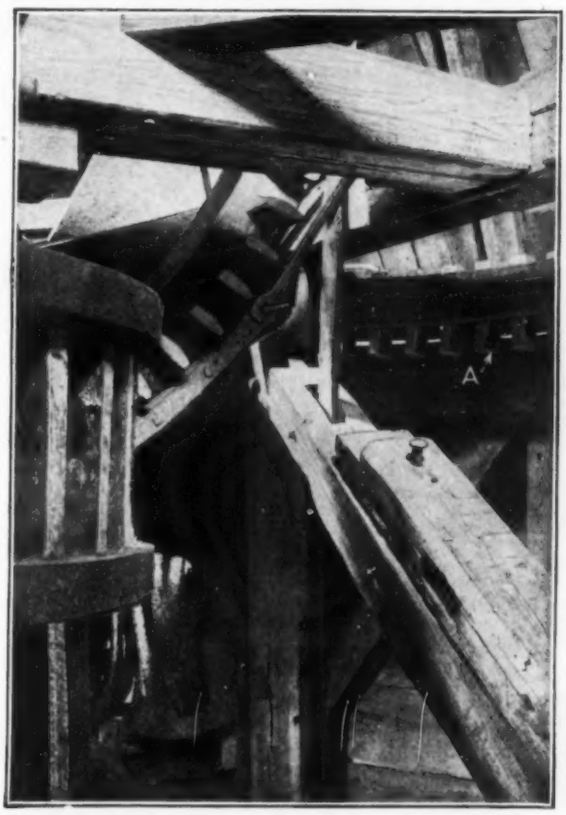


FIG. 5. BRAKE WHEEL, BRAKE BEAM, CENTER WHEEL AND CIRCULAR RACK

Cod, at least, the journal was sometimes armored with straps set parallel to the axis. The back end of the shaft, which opposes the thrust of the wind against the sails but is lightened horizontally by their weight as a balance, is furnished with a pin thrust bearing.

The wind shaft carries a great vertical gear, the

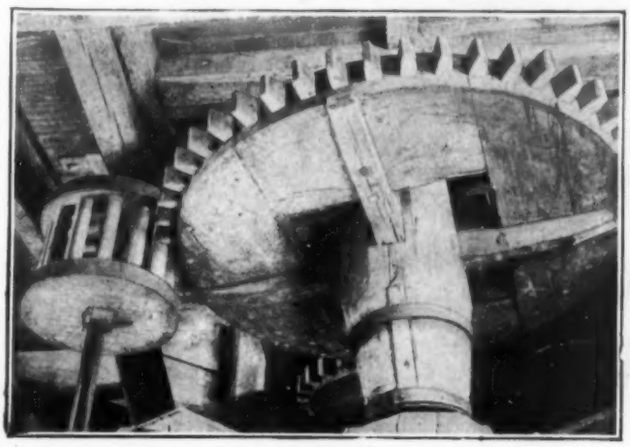


FIG. 7. MAIN DRIVING SPUR GEAR

brake wheel, with face teeth. It meshes with the center wheel, usually a large horizontal-pinion lantern gear, or "trundle head," on a shaft axial to the mill, which, reaching down through the floor into the middle story or grinding room, is equipped under its ceiling with

the big spur wheel that acts as a driver for the trundle heads on the iron spindles of the two rotating millstones.

Over the vertical wheel in the head passes a brake band of hickory, and attached to it is an undergrowth of thicker wood shaped out. The hickory band is drawn tight by a heavy beam lever, sometimes additionally

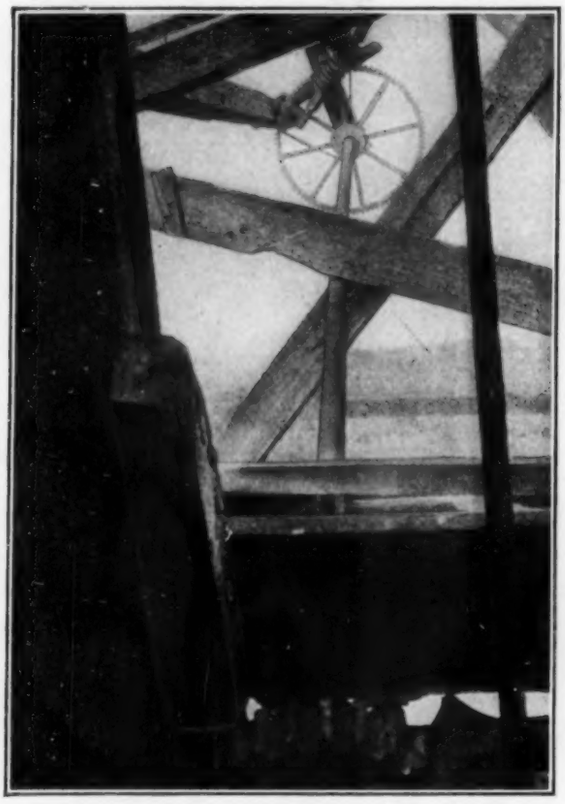


FIG. 6. AUTOMATIC-TURNING AUXILIARY

weighted and containing a sheave for a rope which reaches to the lower part of the mill. I am not sure whether the rope runs first upward over a pulley to

FIG. 8. THE STEP BEARING

relieve the weight of the beam for operation or directly downward to increase the brake tension.

The main driving spur gear under the second-story ceiling, with the trundle heads of the stones, is illustrated in Fig. 7. This, like Fig. 5, is in the mill recently purchased and restored by Mr. Buek, where much new woodwork is evident. The step bearing of the vertical shaft at Hay Ground is shown in Fig. 8. To lift the stones for pecking, etc., a wooden gib crane is provided. On Shelter Island we saw the hoisting operation in process, Fig. 9. Here the wooden yoke carrying the suspending hooks for the stone is forced upward by a wooden screw *A* which passes through the crane beam.

THE GOVERNORS BELOW

On the ground floor we find the bolt, bins and other equipment necessary to a flour mill. The most interesting features mechanically are the governors. The pressure of the stones and the feed are automatically regulated more or less satisfactorily by placing under each pair a Watt centrifugal governor such as is used

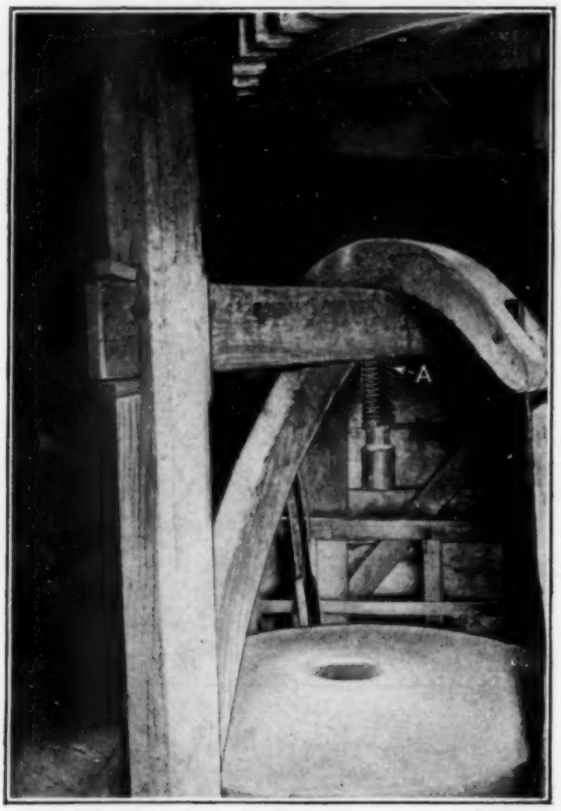


FIG. 9. GIB CRANE FOR LIFTING THE STONES

in steam engines. The spindle carrying the upper stone, or runner, and passing down through the lower stone, is supported by a step bearing, Fig. 10, on a beam which is pivoted at one end, so as to allow it a slight rise and fall. At the other end this beam is adjustably suspended by a hanger formed of two segments mutually offset and connected by the short arm of a steel yard or lever, its long arm being controlled by the governor. As the balls fly apart the long lever arm is allowed to rise, thus slightly lowering the beam and with it the upper millstone. This lessens the space between the stones, increasing their mutual pressure, and at the same time, it is said, the feed of grain is automatically increased. In Fig. 10, taken at Water Mill, the mechanism is unusually low down and compact, and the free ends of the beams supporting the governors are toward the center instead of outward, as illustrated in the more typical section, Fig. 2. The Shelter Island mill is dis-

tinguished by three-ball governors. Those of four balls have sometimes been used, but I have not seen any on Long Island.

We shall not consider here the auxiliary mechanism of the windmills, such as the bolting machinery and its drive, the corn shellers or the homemade hoist by which the miller relieved himself of the labor of carrying the bags upstairs on his back. Curious are the

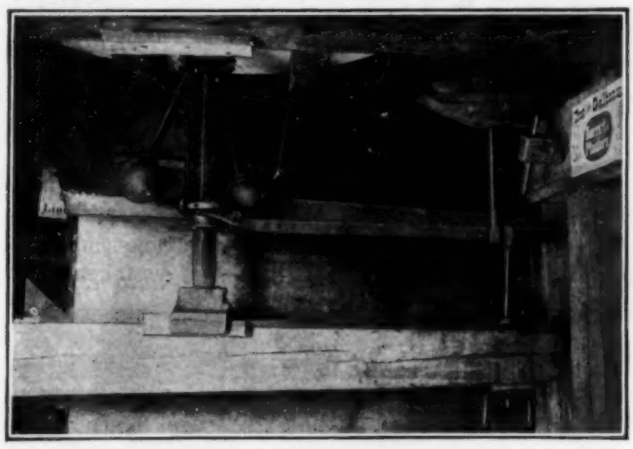


FIG. 10. TWO-BALL GOVERNOR

crude methods of throwing the pinions in and out of gear. Their shafts are fixed at one end, but the other can be swung far enough aside to disengage the cogs and secured in position by wooden keys, wedges, etc.

Much of the information in this article has been obtained through the courtesy of the persons whose names appear herein and from mill owners and others. The old practical windmillers are rich in reminiscence, and their experience could serve as the basis for a volume on the subject.

Drill Jigs for Irregular Castings

BY CHRISTIAN F. MEYER

In Fig. 1 is shown two parts *A* and *B*. Part *A* has no finish whatever before drilling, but part *B*, a roller shifter, has the forked part finished on the flat surfaces. Considerable difficulty was experienced in drilling these parts accurately until the jigs described in this article were built.

Fig. 2 illustrates the jig for drilling part *A*. It is important that these holes should be in perfect alignment, and the difficulty of accomplishing this will be readily apparent. If the casting is not held tightly enough the pressure of the drill will spring it and the resulting holes will be out of line; on the other hand, if too tightly or improperly held, the long, thin casting will be sprung out of line by the pressure of clamping and will spring back when the clamps are loosened, with the same result as before.

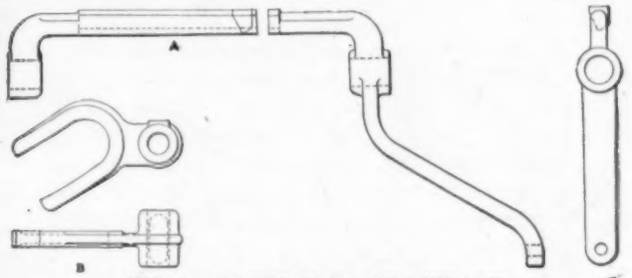


FIG. 1. CASTINGS TO BE DRILLED

The jig is used on a horizontal drilling machine. It consists of a cast-iron base *A* and a swiveling top *B*, the latter turning on a suitable stud. A locking pin *C* operated by the handle *D* serves to hold the top plate in either of two positions parallel with the center line of the hole to be drilled.

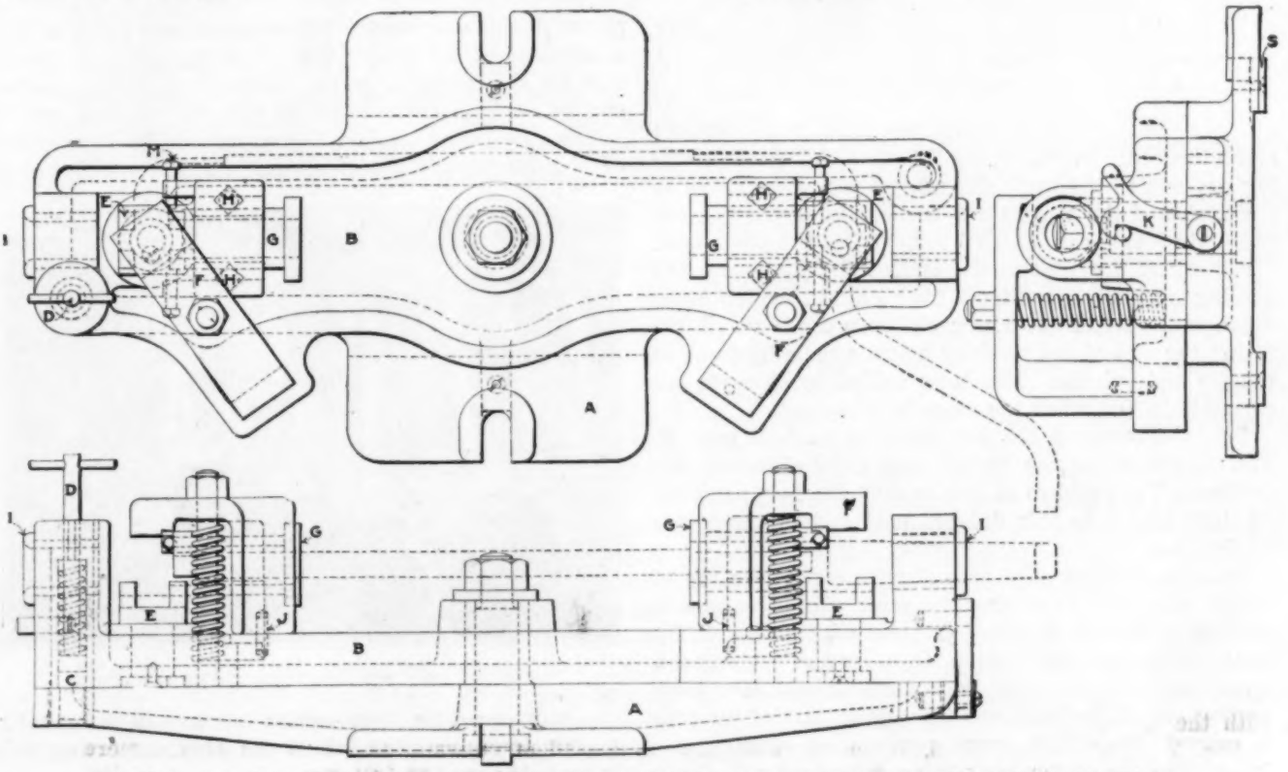


FIG. 2. JIG FOR DRILLING HOLES IN THE IRREGULAR-SHAPED CASTING SHOWN AT "A" FIG. 1

At each end of the top plate steel V-blocks *E* are provided which revolve freely about vertical axes. The hubs of part *A*, Fig. 1, are laid into these Vs which, floating upon their axes, take a position parallel to the hubs, allowing the clamps *F*, Fig. 2, to hold the work without danger of springing it. The hubs are kept central as the centers of the studs about which the V blocks turn are located on the center line of the jig.

To preclude the possibility of springing the work by the pressure of the drill, the bushings *G* are pushed against the work and then clamped tightly by screws *H*. At first these bushings were threaded, but there was a tendency on the part of the operator to screw them up too tightly and thus bend or spring the castings, so the sliding bushings were substituted.

Bushings *I* guide the drill in entering the work. To make any movement to the side impossible, setscrews are provided which bear against the hubs while the latter

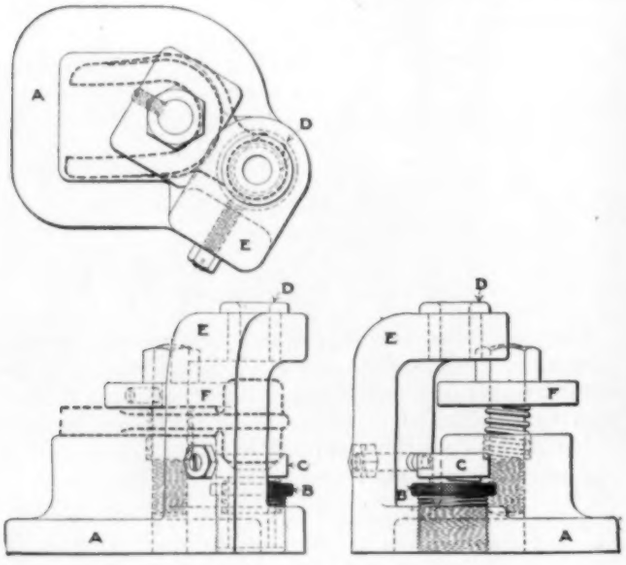


FIG. 3. JIG FOR DRILLING PART D

are being drilled. The clamps are held up by springs and prevented from turning by pins *J*. After drilling one end of the work, the nut on the central stud is loosened, and the top plate *B* turned 180 deg. when the index pin locks it in position for drilling the other hole.

A hook *K* provided at the end of the jig where the drilling is done is now slipped over a pin in the top plate, drawing the latter down securely upon the base. A rib fitting the slot of the machine assures the alignment of the jig and spindle. The holes drilled by this jig are correctly in line when the work is taken out.

Fig. 3 illustrates the jig designed to drill part *B*, Fig. 1, which has the forked part finished before the drilling. The problem is now to drill the hole perfectly at right angles to this finished part and in the center of the boss.

This jig consists of a base *A* with a pad, the top of which is finished to receive the work. Into the base is screwed a bushing *B*, which is fitted with a plug *C*, the latter being pressed upward by a spring. A suitable screw prevents the plug from turning and also from coming out of the bushing. The upper part of the plug is cupped out with a round cone-shaped opening into which the base of the work to be drilled enters. Guide bushing *D* is secured in the upper end of the bracket *E* in line with the lower bushing.

The boss is set into the cone-shaped opening of the plug and the finished part held down by being clamped under the collar *F*. The plug *C* will be pressed down and at the same time will keep the center of the boss guided by its opening to coincide with the center line of the upper bushing. As soon as the work is clamped down the bushing *B* is screwed up to support the plug *C* and prevent bending or springing of the work. The parts drilled by this jig are entirely satisfactory.

In a French Shop

By Robert K. Tomlin, Jr.

The illustrations here shown depict some of the work now being carried on in the Salmson shop in France and, particularly in the case of the machine-shop view, they show the extent to which women have taken men's

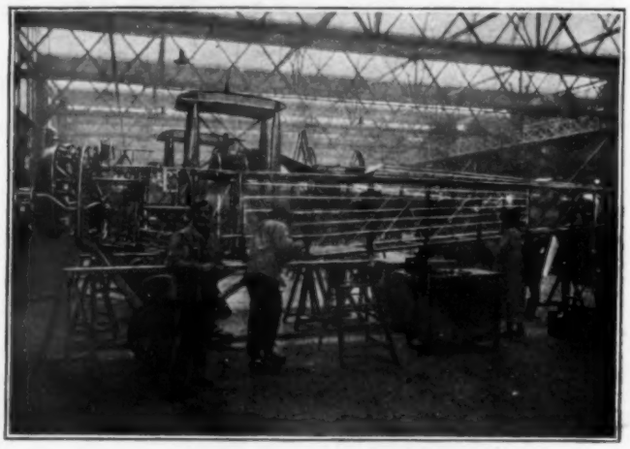


FIG. 1. FITTING UP A FIGHTING PLANE

places in this war work. These women are turning the crankshaft of the rotary type of motor shown in position on the airplane in the other view. These shafts can be seen in their racks at the end of each lathe.

The view in the airplane factory shows the assembling of a rotary-motor machine, which seems small for a

FIG. 2. WOMEN TURNING CRANKSHAFTS

two-man machine, but which shows an adjustable machine-gun mounting behind the wing, indicating that it probably carries two men.

War Sparks from Industry's Forge

Edited by E. C. Porter

W. C. Potter, Acting Director of the Bureau of Aircraft Production, who recently made an inspection of factories building planes and motors, states that Liberty motors have reached quantity production and that American-built airplanes are being shipped in trainload lots from the factories for service overseas.

* * *

The work of rebuilding the TNT plant at Morgan Station, N. J., which was wrecked last week by a series of explosions, will be begun at once. Decision was made by the Construction Division of the Ordnance Department and the contract awarded to T. A. Gillespie Sons & Co. Laborers are being mobilized and work has already been begun under the supervision of the Construction Division. The proximate cost will be between $5,000,000 and $10,000,000.

* * *

The indefinite continuation of the daylight-saving schedule has been proposed in a bill introduced by Senator Calder of New York, with the indorsement of Chairman Baruch of the War Industries Board, who believes daylight saving should continue as a coal-conservation measure. Under the present law all timepieces will be turned back an hour on Oct. 27. Investigations by the board in 20 of the largest cities show that in all but Pittsburgh large quantities of coal were saved by the law, and it is estimated that in those cities alone 100,000 tons would be saved this winter.

* * *

The erection of a TNT plant at Giant, Calif., has been authorized. It will be located adjacent to the nitric-acid plant of the Giant Powder Co. The land belongs to the powder company, but will be leased to the Government with option of yearly renewals. The Government is to remove the plant whenever it believes further maintenance unnecessary. The contractor is Grant Smith & Co. of Seattle, Wash., and the work of construction will be under the supervision of the Construction Division of the Army. The plant will be operated by the Giant Powder Co. The estimated cost is $1,438,000.

* * *

A new hotel, which will be used for housing the employees of the Willys-Overland Co., Toledo, Ohio, who do not have families, is being built. It is a two-story structure and the first unit, which is about completed, will maintain accommodation for 250 men. The building of the hotel is to provide modern sanitary, convenient quarters at reasonable prices near the plant for unmarried men or new employees coming there from other cities until they find permanent quarters elsewhere. A rate of $6 a week will be charged, and will include lodging, three meals a day and shower bath. The mess hall on the ground floor will seat more than 300 men at one time.

Additions to the plant of the Hero Manufacturing Co. of Philadelphia, which is manufacturing for the Ordnance Department, have been authorized by the War Department. The estimated cost of the facilities, which will speed up production, is $150,000. This construction consists of three buildings 200 ft. long by 200 ft. wide, of the type provided for manufacturers in other cities under similar arrangements. In addition there will be erected a temporary corrugated-iron steel-frame boiler house 30 x 30 ft. The work will be done under the direction of the Construction Division.

* * *

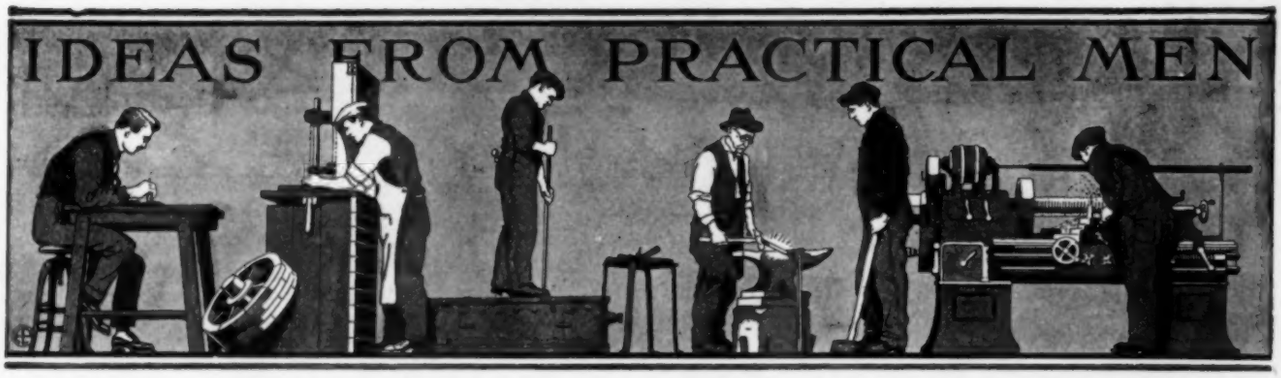
The United States Printing Office in Washington, D. C., is the largest establishment devoted to printing in the world. During 1917 the 154 presses printed no less than 34,000,000 lb. of paper, or from nine to ten carloads a working day. At the present time fourteen tons of postal cards are turned out every day. There are 5700 persons employed in the mammoth establishment, the average daily payroll of which amounts to about $17,500. The fact that every process necessary to the production of a piece of printed matter is used on the premises makes it one of the best-equipped printing offices in the world as well as the largest.

* * *

The number of women serving as drivers and aides in the American Red Cross Motor Corps Service now exceeds 6000. The drivers have to pass a standard of physical fitness, driving proficiency, mechanical knowledge, resourcefulness in case of road accident, etc. A khaki uniform was at first adopted, but has been discarded and a new uniform of Red Cross Oxford gray substituted. The cars used for this purpose are distinguished by a white metal pennant bearing the red cross and the words "Motor Corps." To the normal duties of these women has been added that of delivering the official telegrams regarding oversea casualties to the relatives of the killed and wounded.

* * *

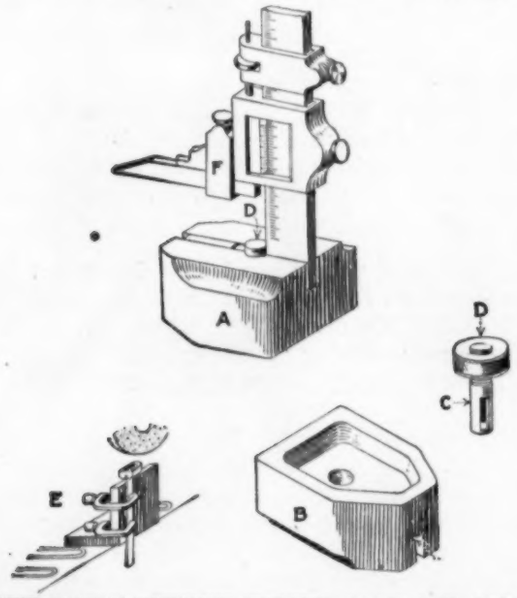
The formation of the National Operation Corporation, which is to supersede the present management of the Smith & Wesson Co., Springfield, Mass., was announced last week. The company will operate the plant for the United States Government. The officers of the new corporation are: President, W. C. Bryant of Bridgeport, Conn.; vice president and general manager, E. F. Russell, Springfield, Mass.; secretary and treasurer, H. C. Heiden, Springfield; board of directors, the foregoing officers and Lieut.-Col. Lindey D. Hubbel, Acting Commandant of the United States Arsenal, Springfield, and F. A. Merrick. Mr. Heiden is the only member of the new board who has been connected with the Smith & Wesson Co. The corporation was formed, it is announced, under the direction of officers of the federal Government.



Making a Height Gage Out of a Vernier Caliper

By Hugo F. Pusep

At the present time it is practically impossible to buy vernier height gages owing to the unprecedented demand for them, and the necessity of waiting, sometimes for long periods, for an opportunity to use the gage owned by the shop led me to use this otherwise unprofitable time in making an attachment for my 6-in.



A CONVERTIBLE VERNIER HEIGHT GAGE AND CALIPER

vernier caliper which would transform it into a height gage without interfering with its other sphere of usefulness.

Many toolmakers who do not possess a height gage own a 6-in. vernier caliper, and the few simple accessories shown in the drawing will make of it a convertible tool that will perform the duties of either.

I have my vernier caliper so equipped, and would not now exchange it for the regular tool, as its accuracy could not be surpassed by the latter and it is more convenient and adaptable.

The base, shown at *A* in the assembled tool and at *B* in a reversed position, is made of tool steel, the small holes indicated by the arrows being drilled clear through to facilitate grinding the bottom of the slot. The pocket on the underside serves to lighten the tool and to provide a recess for the nut which holds the parts together. The slotted stud *C* and its nut *D* are made of cold-rolled steel and should be casehardened to resist wear. The stud is a slip fit in the hole through the base, and the slot in the stud is made just large enough to allow the fixed jaw of the caliper to be easily set in place.

The slot in the base is of course accurately ground to fit the fixed jaw of the caliper, which should also have a light cut taken over the back to insure accuracy. The base should be ground on the bottom after assembling, the manner of holding the tool for these operations being shown at *E*.

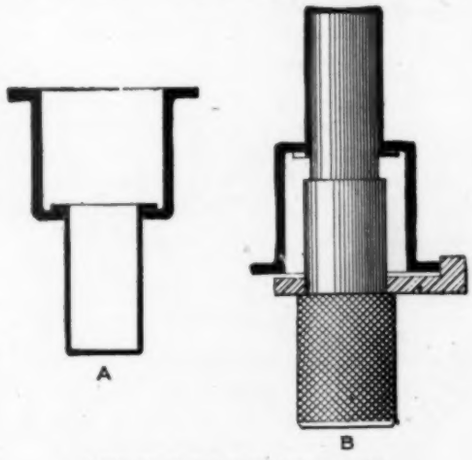
A few passes over a good lapping block to remove the wheel marks will finish the base.

The scriber clamp shown at *F*, which can also be used to attach an indicator, is too familiar to need description.

A Gage for Testing Concentricity

By Joseph Ahlers

The extensive manufacture of munitions has developed a new type of gage which is practically unknown outside of the arsenals or Government shops. This tool is called the concentricity gage and is used for testing



THE CONCENTRICITY GAGE

the concentricity of assembled parts that have been brazed, welded or soldered together. A good example of this class of work is the fuse socket and fuse-socket holder for 75-mm. shells. The pieces are made separately by means of draw-press dies and are then soldered together at the flange as shown at *A* in the cut.

Concentricity gages may be of varied types. A gage

for inspecting the part shown has been made as at *B*, which is composed of a straight stud and handle and a gaging finger. The stud is ground to the diameter of the fuse socket within a limit of 0.00025 in., and the finger is pressed on the stud against a shoulder and lapped to the required dimension within 0.0005 inch.

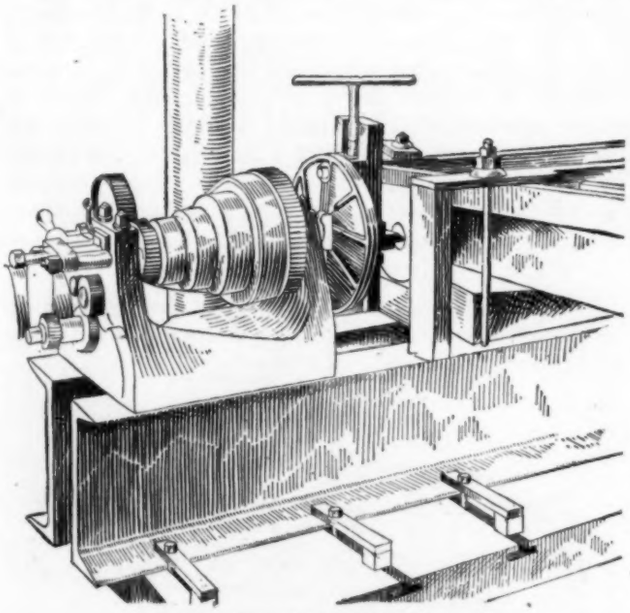
This is the simplest type of gage and only tests the concentricity of the flange. There may be more than one diameter on the larger piece, and this would require a more complicated tool, or possibly two tools.

This type of gage is made for small work. On large work the gage is made by driving the stud in a baseplate, and in place of the finger there is an upright rod which holds an indicator. Inspection of large pieces is a slower operation than small work as it is much easier and quicker when one can take the work in one hand and the gage in the other and does not have to read an indicator.

Facing the Boss on a Large Casting

BY H. E. MCLEAN

Some time ago some castings weighing about two tons each were delivered to our shop for the purpose of having a boss that was on one end of the castings faced off. There were no planing machines in the shop large enough to do the work nor had we any convenient means of handling such heavy pieces, therefore it was necessary not only to devise a way of removing the



FACING BOSS ON LARGE CASTING

stock, but to do it in such a manner as to involve the least amount of handling, both of which requirements were met as here described.

The set-up is shown in the illustration. Two 18-in I-beams were bolted to the floor plate of a radial drilling machine, parallel and a convenient distance apart, to which at one end was bolted the headstock of a lathe in position to bring the cone into alignment with the cone of the radial, the drive being by belt from the latter.

On the faceplate of the lathe was bolted a facing attachment. The castings were put in place with a couple of chain blocks, bars, roller, etc., and secured in position by long T-head bolts running down to the slots in the floor plate.

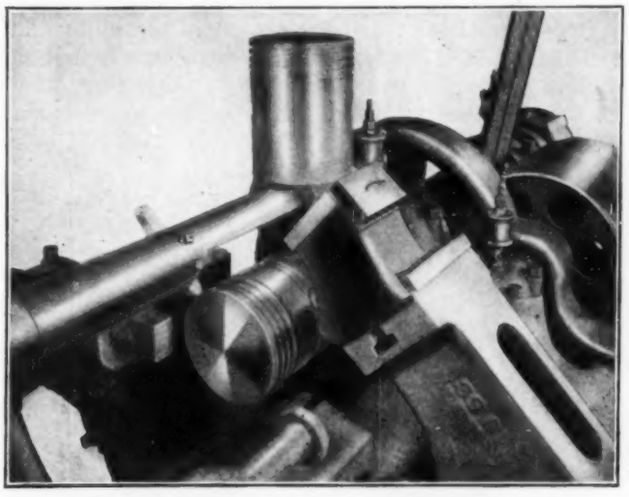
The time required to face each casting was about 45 min., and the operation did not interfere with the continuous use of the drilling machine.

Machining a 5¾-In. Piston on a 3¼-In. Gridley Automatic

BY H. W. WOOLUMS

Not having a sufficient quntity of this work to warrant a special machine, and yet desiring to take advantage of the lower operating cost of the automatic, we designed the fixture here described and shown in the cut to accomplish the third operation which includes facing, turning and chamfering a 5¾-in. gas-engine piston and cutting the oil and ring grooves.

It is not posible to show all the tools in the picture. The forming-tool holder carries the tools for facing the end, chamfering, cutting the oil grooves and rough-



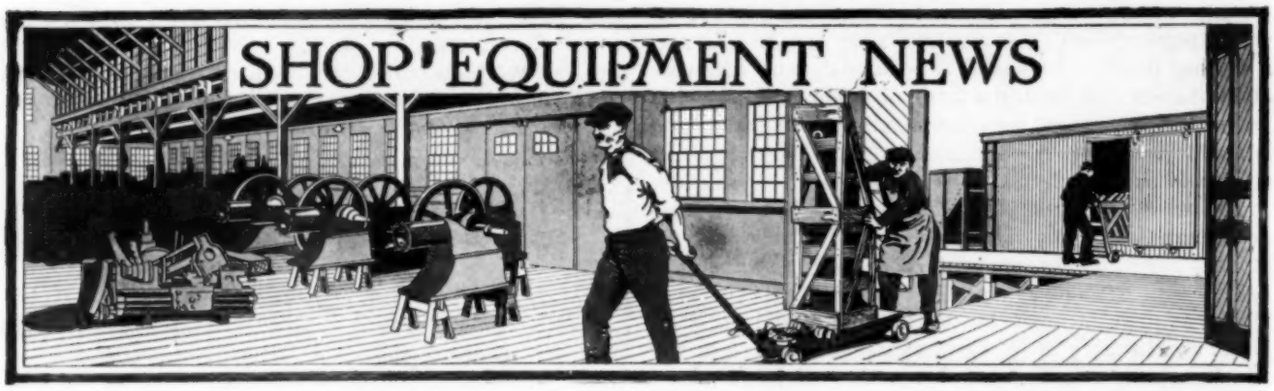
FIXTURE FOR TURNING PISTONS

ing the ring grooves to within $\frac{1}{64}$ in. of size. The rear block carries the tools for finishing the grooves to size.

The turning tool is carried in a 3-in. round cold-rolled steel bar which is operated by a fixture attached to the turret. The forward end of this bar slides in a bearing provided by a casting which is bolted to the head of the machine, and is cut away as shown to clear the main bearing. The actual bearing for this pilot bar is made by pouring babbitt around it after assembling. There are but two cams on the cam drum, one for the forward movement and one for the return. The turret is not indexed. As the tools are all working at once the turning time covers the time of the operation.

The spindle speed is 48 r.p.m. The turning tool is No. 3 stellite, all the others being high-speed steel. The countershaft pulleys are arranged to use two 2¾-in. double belts for driving.

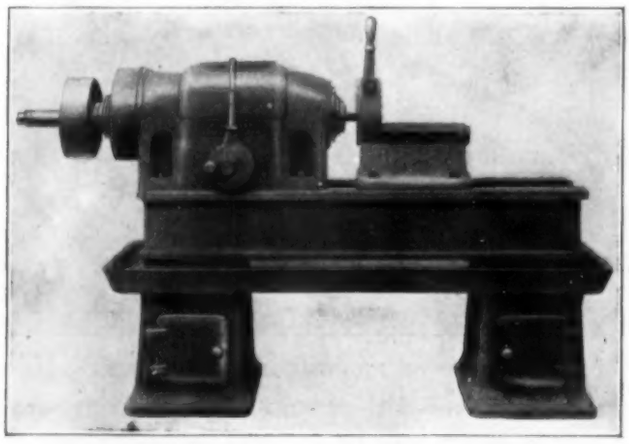
The work was formerly done on hand-operated screw machines with a working time of 1 hour for the operation. The time consumed by this method is 12 min., and as there are four machines handled by one operator the labor cost, assuming a wage rate of 40c. an hour, is reduced from 40c. a piece to 2c., which saving will soon pay the cost of the fixtures.



This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist"

Hall Planetary Thread-Milling Machine For Shell Work

The thread-milling machine here shown is claimed by its maker, the Hall Gas Engine Co., Bridesburg, Philadelphia, Penn., to be a new type for milling internal threads. The feature of the machine is that the milling cutter moves around inside of the work, which is held stationary at all times. It is claimed that

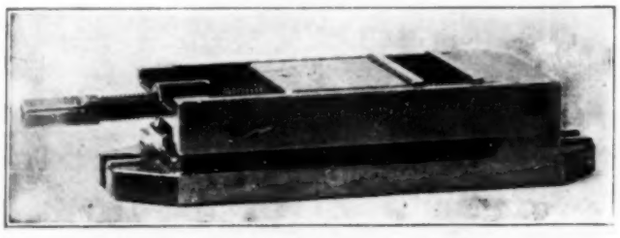


HALL PLANETARY THREAD-MILLING MACHINE

this system not only makes for more accurate work but provides for greater speed in that the work and chuck do not have to be started and stopped. After the work is placed in position the speed lever is moved to the starting point, causing the milling cutter to move radially to its proper depth and then travel on its proper radius for one and a fraction revolutions, cutting the complete thread. After the planetary movement is completed the cutter automatically moves back to the center of the main spindle and remains in this position until the feed lever is again operated. Immediately after the cutter returns to the center of the main spindle, the main spindle returns automatically to the point of starting. Among the advantages claimed are that no cross or longitudinal feeds are used and that no time or power is wasted in starting or stopping the work and chuck. The accuracy of the machine is said to be increased by the fact that there are no sliding ways or table feeds to keep tight and that the rapid moving of heavy work in and out of the machine chuck cannot affect the accuracy of threading, as it is not on a movable table having feeds and adjustments, the chuck being fastened directly to the bed of the machine. The milling cutter is held on a 2-in. spindle with collet-type bearings, while the main spindle is 6½ in. in diameter with bearings of the same type. The machine is made in two sizes, No. 1 having an internal-threading capacity up to 6 in., a maximum swing over the bed of 18 in., a chuck capacity of 14 in., and a distance from the center of cutter to the top of the bed of 9 in. The No. 2 machine will cut an internal thread up to 12 in. in diameter, has a maximum swing over the bed of 24 in., a chuck capacity of 14 in. and a distance from the center of the thread-milling cutter to the top of the bed of 12 in. Pitches from 30 threads to the inch to 1 in. may be cut on either machine with one and a fraction turns of the main spindle, using a multiple ring cutter. Both machines may be equipped to cut double, triple or quadruple threads by the use of a single or a formed milling cutter.

Edlund Milling Vise

The vise shown in the illustration, which is fitted with side bars for taking the clamping strain, is one of the recent products of the Edlund Machinery Co.,

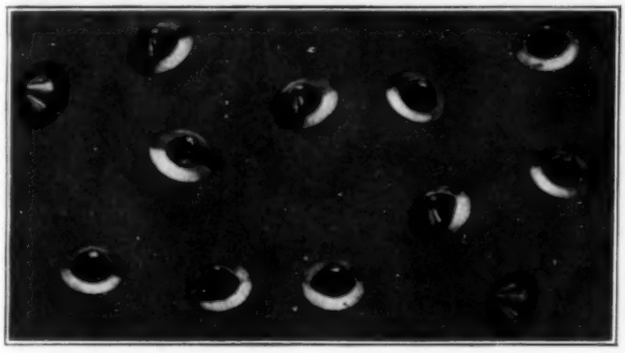


EDLUND MILLING VISE

Inc., Cortland, N. Y. The advantage claimed for this construction is that the stationary jaw will remain square with the vise regardless of how much pressure is applied to the screw. Another feature of this vise is that the side bars operate a cam arrangement which moves the sliding jaw away from the work when the bars are raised and up to the work when the bars are lowered, the final clamping, of course, being done by means of the square-head screw at the end of the bar. These vises are at present made in 4-, 5-, 6- and 7-in. sizes.

Abbott Burnishing Cones for Work With Small Crevices

The Abbott Ball Co., Hartford, Conn., is now turning out a new style of burnishing material known as burnishing cones, these being intended for use in connection with burnishing balls for getting into small crevices or for figured work. These cones take the form of a flat disk with a small cone protruding from either

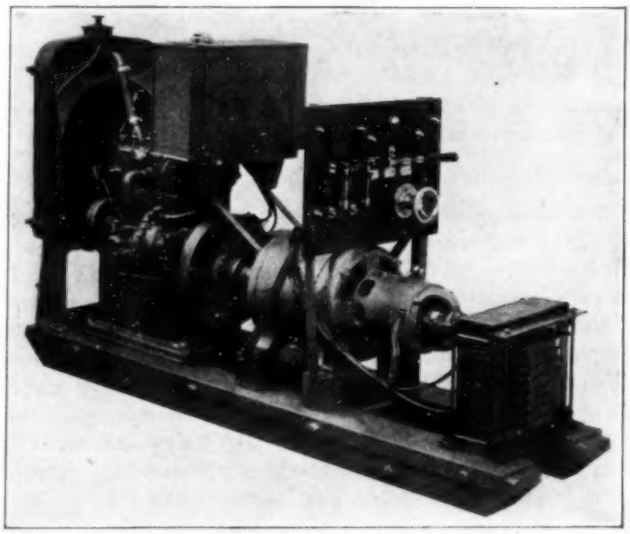


ABBOTT BURNISHING CONES

side, and on account of this shape either the edge of the disk or the point of one of the cones will come in contact with the work and will reach into small sharp corners. The cones are about ¼ in. in diameter, the illustration showing them somewhat larger than they actually are.

Lincoln Portable, Direct-Current Arc-Welding Outfit

The portable arc-welding outfit illustrated is one of the recent products of the Lincoln Electric Co., Cleveland, Ohio. The outfit is portable for operation where electric current is not available and consists of a 150-

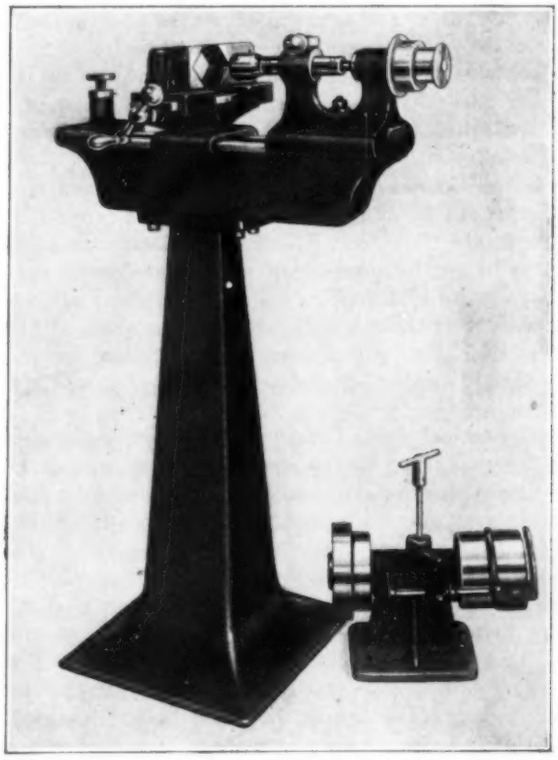


LINCOLN 150-AMP. PORTABLE ARC-WELDING SET

amp. arc-welding generator direct connected to a Winton gasoline engine. An interesting feature of the machine is the method used to insure a steady arc and a constant and controllable heat. A compound-wound generator is used, the series windings of which are connected to oppose the shunt field, the two windings being so proportioned that the voltage increases in the same ratio that the current increases, thus limiting the short-circuit current. Another important effect of this is that the horsepower, and therefore the heat developed for a given setting of the regulator switch shown on the control board above the generator, remains practically constant. It is claimed that this method of control gives considerably more work on a given amount of electricity than where the machines use the ballast resistance. Additional arc stability is insured by the stabilizer at the right of the illustration, this being a highly inductive low-resistance coil connected in the welding circuit and serving to correct momentary fluctuations of current.

Middletown Centering Machine

The machine illustrated is a centering machine now manufactured by the Middletown Firearms and Specialty Co., Inc., Middletown, Conn. It is designed to center round, square or octagonal stock, and it is claimed that it will do this operation to within one-



MIDDLETOWN CENTERING MACHINE

thousandth of an inch of the true center in regard to the outside surface. Two speeds are provided, one for hard and one for soft stock, and a rest relieves the jaws of undue stress. An adjustment allows the machine to be set off center for doing work with eccentric centers It will take round stock from $\frac{3}{16}$ in. to $3\frac{3}{4}$ in. in diameter, and is provided with a stop so that all work is centered to a uniform depth.

The column is of the box type and the head casting is bolted to it as shown in the illustration. A countershaft of the single-hanger, rod-operated type is furnished with the machine.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., Oct. 12—Standardization promises to be as big a bugaboo as was interchangeability earlier in the war. It has been particularly noticeable in army trucks; it has also been the excuse for much of the delay in airplanes, and this fad cannot escape responsibility for most of the delay that has taken place in both these branches.

All practical men realize the advantage of standardization and of interchangeability in their proper places, and no one raises the slightest objection to either unless it causes delay in securing much-needed material, in this case vehicles of the air and of the road. That both of these necessities have been delayed by attempts at standardization is an open secret in quarters where the facts are known.

It is well known that at least four American trucks gave splendid account of themselves in France before we went into the war. There were thousands of each of them in service, enough of each to make the matter of spare parts and repairs an easy problem; almost as easy in fact as though they had all been alike, although we all admit that might have been an ideal condition. But ideals do not often become a reality in matters of this kind.

The practical manufacturer would not delay equipping his plant for war work in order to get all hand screw machines of a certain make; nor would he stop to design a new one for a standard one when he could get them much more rapidly by splitting his order among the best known builders. The equipment of almost every munition plant is proof positive on this point.

But instead of ordering large quantities of trucks from the regular builders of standard makes which they were well equipped to supply at a rapid rate, the standardizing bug got to work, the germ being liberated, if not actually injected, by the makers of auto parts who saw a great opportunity for getting business in large-sized chunks and also of putting them in the essential list. So an erstwhile electrician was borrowed from the navy, not because he knew trucks, but because he seemed to be as easy to teach as anyone else. And with this as a foundation, the standard truck based on Army experience in Mexico and not on conditions in France came into being. The result was that a rear-axle ratio of 80 to 1 was demanded, this being necessary to pull the truck out of the Mexican gumbo soil or over the boulders that cross the roads in that country.

Standard truck builders, those whose trucks are doing and have done the best work in France, where as is generally known the truck saved the day at Verdun and other prominent places, protested against this ratio. Their experience, backed by long years and thousands of dollars, indicated that a ratio of between 50 and 60 to 1 is much more suited to the work to be done. These protests were unheeded, however, and as a result there seems to be good reason to suppose that every rear axle will have to be replaced after less than 10,000 miles of use.

The fever of standardization went so far as to include a ¾-ton truck in spite of the fact that Ford builds an excellent 1-ton truck, of which he could supply one thousand a day, if need be, at half the price of the alleged standard truck; furthermore the motor and many other parts would interchange with every Ford ambulance in France, and there are thousands of them. The new truck defeated this very important feature, and the foolishness of it was so apparent that it has been abandoned after wasting much time and money on it.

After finding that the standardized truck could not be satisfactorily produced in sufficient quantities, tests were held of standard trucks in spite of the fact that they had all been war tested under the most trying conditions during four long years in France. The standardization germ was still at work, and large builders of well-known and highly successful trucks were asked to stop building their own trucks and make fixtures, tools and gages for trucks of another builder's design. In addition to this they were asked to build them at a lower price than the shop that developed them and that had all special equipment already charged off the books.

Sanity Seems To Have Returned

The disease seems to have worn off, however, and the standard makers have orders for trucks of their own kind, which is as it should be. The waste of time is of more importance than the waste of money, although we should be mighty glad to have that to help pay the interest on our bonds, which will continue to amount up until the war is over, and perhaps after. We are all ready to pay whatever price may be necessary to "swat the Hun," but if we can pare a few millions off the bill by saving unnecessary waste we will appreciate it later more than we do now.

The auto-parts makers need have no worry about getting out of work. They can well be utilized in making spare parts for the standard trucks and so leave the builders of these trucks free to go ahead on complete units. We need them all and they can be of more service in this way than by messing up the truck situation.

The Coming Annual Meeting of the A. S. M. E.

Plans for the annual meeting of the American Society of Mechanical Engineers to be held Dec. 3-6 have so far developed that tentative announcement of several of the sessions can now be made. The practice in previous years of having a leading subject of broad general interest for the meeting will be adhered to, with a discussion throughout Wednesday, Dec. 4, of the general topic on "Human Engineering," particularly in reference to questions of administration which have arisen in the war industries. The titles of the papers now in preparation for this session are as follows: "Organization," "Standardization and Administration of Wages," "Nonfinancial Incentives," "Incentive of Control in Industry," "Employment of Labor," "Dilution of Labor," "Intensive Training" and "Human Relations in Industry."

There will be at least two sessions for general papers of technical interest for which an ample variety of strong contributions have been received.

One session will be under the auspices of the gas-power subcommittee with papers on oil engines and cooling losses in combustion engines. Another session will be in charge of the subcommittee on textiles, with papers on industrial power problems and airplane fabrics. A session arranged by the subcommittee on machine-shop practice will be devoted to the subject of gages, methods of manufacture and testing. The apparatus in the department of the Bureau of Standards, located in the Engineering Societies Building, New York, will be added to with a view to placing the equipment on exhibition during the meeting.

Another session will be a joint session with the American Society of Refrigerating Engineers, which holds its annual convention simultaneously with that of the society. Papers will be contributed by both societies.

Everything points to a most successful meeting equaling if not exceeding those of the last two years, which have been the largest in the history of the society. On Wednesday and Thursday evening of the meeting there are to be addresses or motion pictures relating to the war, and the trend of many of the papers at the special sessions will be in the direction of the work that the members of the society and other engineers are accomplishing in the one all-absorbing undertaking of the present.

"Does He Get It?"

BY LUTHER P. BURLINGAME
Brown & Sharpe Manufacturing Co.

In advertising the Fourth Liberty Loan bonds a "flyer" widely distributed shows one of our boys in the thick of the fight and reads:

After *this* day's work he will need a new outfit. Does he get it?

In a letter recently received from a member of one of the crack American batteries which distinguished itself in the thick of the fighting at Château-Thierry and on other fronts in "the big drive" he says:

The weather has been exceptionally cold lately. It is impossible to keep warm under one blanket all night, and we will be very much pleased when we get our overcoats, winter underclothes and another blanket. We seem to have great difficulty in obtaining any kind of clothing. That is one reason we are not on the firing line now; but we are not far from it, and I think just as soon as we can get some clothes we will be in the scrap again.

At the time of the receipt of this letter by a New England family thousands of mill workers in that vicinity were out on strike, and had been for many weeks, making demands for a material increase in pay even though already paid more than the prevailing wages for their work.

It is believed that if such strikers could be brought to realize the close connection between their product and a successful advance of our troops at the front, to say nothing of conserving the health and comfort of our boys, selfish and personal interests would be set aside in the interest of the common cause. Whether workmen are engaged in making clothing or munitions, or whether it is machinery that is back of the production of war material, the need is the same, and it is essential that there shall be "no inefficiency or slackened power," even if it requires self-denial to keep at the job.

What success has been attained in the vast enlargement of our whole military program has come from such self-denial, and we can be thankful that the cases have been comparatively few where through enemy influence or greed the needs of our army have been hampered by the shutting down of essential industry. However, we must not lose sight of the insidious influences at work, and must resolve to keep every wheel turning and every energy exerted to the utmost until the victory that we now have in sight is completely won.

Tool and Gage Designers Wanted for Naval Work

The naval gun factory needs competent tool, jig and gage designers. Graduates in mechanical engineering from a technical school or college of standing, who have had some drafting-room experience, or men who are competent designers of jigs, tools and gages and have had a number of years' experience in the designing of shop tools are eligible for these positions.

The pay ranges from $4 to $6.88 a day, depending upon the qualifications of the draftsman. Additional information may be had by addressing the Commandant and Superintendent of the naval gun factory, Navy Yard, Washington, D. C.

Developing Plans for Foreign Trade After the War

The annual convention of the American Manufacturers' Export Association, which will be held in New York on Oct. 30 and 31, according to announcement, will be made a medium through which the manufacturers of the country can establish definite plans for developing the country's foreign trade after the war. In addition to the 1000 exporting manufacturers who are members of the association the convention will call into conference all other American agencies interested in furthering the country's foreign trade. The association has invited representatives from every chamber of commerce and from every trade and manufacturing

(Continued on Page 736c)

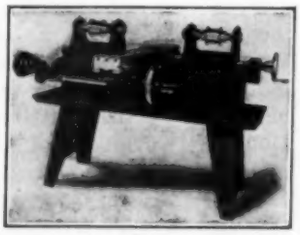
Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Grinding Machine for Milling Cutters, No. 78
William O. Barnes, Leominster, Mass.
"American Machinist," Sept. 26, 1918

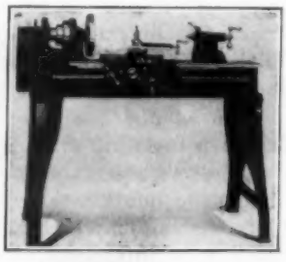
The purpose of this machine is the grinding of complicated gang-milling cutters with straight, spiral radial or undercut teeth. A pin projects from the surface of the table in line with the front face of the wheel, and serves as a guide for the templet that is mounted on the fixture for holding the gang of cutters, thus allowing the cutters to be ground to the correct contour. Capacity: Milling cutters up to 7 in. in diameter and 8 in. long; shank cutters up to 2 in. in diameter and 8¼ in. long and flat form tools up to 7 in. wide.

Milling Machine, Duplex, No. IX
Garvin Machine Co., Spring and Varick Sts., New York City.
"American Machinist," Sept. 26, 1918



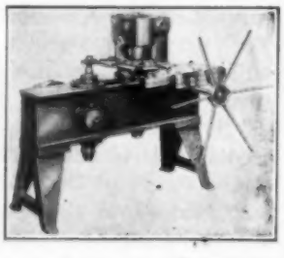
Simultaneous wheel control of the spindle heads is used so that both heads may be moved at one time, but provision is also made for independent head adjustment. The cutters are placed close to the end of the spindles in order to avoid spring. Fixtures may be attached to the table, which is provided with power feed, automatic trip and quick return by handwheel, the changes of feed being by means of a cone pulley driven from the countershaft. The equipment includes pump and piping for cutting lubricant. Feed of table, 34 in.; distance between spindles, 22 in.

Lathe, 10-Inch
Sebastian Lathe Co., Cincinnati, Ohio
"American Machinist," Sept. 26, 1918



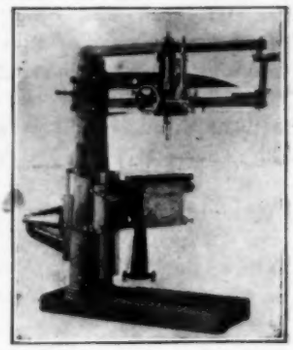
Swing over bed, 11 in.; swing over carriage, 7¾ in.; length of bed, 4, 5 or 6 ft.; front spindle bearing, 1⅞ x 2½ in.; hole through spindle, ½ in.; cone, three step for 1¼-in. belt; distance between centers with 4-ft. bed, 28 in.; width of bed, 8 in.; depth of bed, 7 in.; weight, 450 lb.; size of tools, ½ x ½ in.; travel of compound rest, 3¾ in.; capacity of center rest, 3 in.; centers, Morse taper, No. 2; threads on spindle nose, 10 pitch.

Back-Facing Machine for Cylinder-Base Bosses
Moline Tool Co., Moline, Ill.
"American Machinist," Sept. 26, 1918



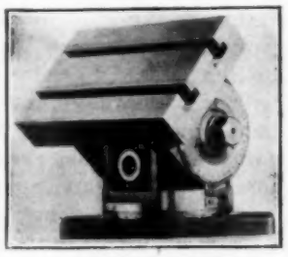
This machine is for back-facing the various bosses on cylinders or crankcases of gasoline engines or other machine parts. Consists essentially of a bed, a slide carrying a master plate on a vertical spindle and an inverted-cutter spindle carrying a milling cutter. The work to be faced is located on the master plate by pins and no clamping is necessary. The master plate has notches around its edge corresponding in location to the bosses to be faced. These notches are engaged and guided by a roller mounted on the cutter spindle below the cutter.

Drilling Machine, Radial, with Swinging Table
Dauber-Kratsch Co., Oshkosh, Wis.
"American Machinist," Oct. 3, 1918



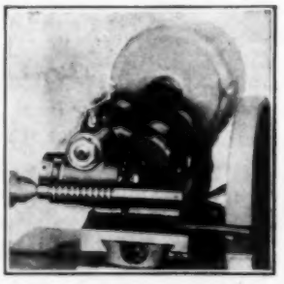
This new type is similar to the standard line except that the elevating table has been so constructed that it may be swung out of the way when large work is to be drilled on the base. A rigid saddle is gibbed to the vertical ways on the column, and to this the table is attached by means of two hinged lugs at the back. The table hinge is not in any sense depended upon to align or to hold the table in position when it is in service, this being done by an aligning key located in the saddle so that the table on being closed lines up properly.

Angle Fixture, "Beckett"
C. H. Tracy Co., 161 Summer St., Boston, Mass.
"American Machinist," Oct. 3, 1918



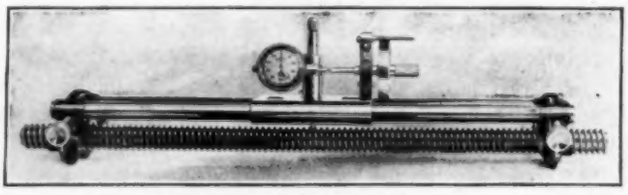
Made in three sizes—5 x 8 in., 8 x 12 in. and 12 x 18 in. Overhang has been practically eliminated and chips and dirt cannot find lodgment on the working surfaces. A gear and pinion are used for inclining the table, while a set of bevel gears control the motion of the top of the fixture in a horizontal plane. Clamping is accomplished by means of a single nut for the base and a single bolt for the table. The table has a range of 180 deg. and has a double vernier. The base is graduated and also has a double vernier.

Thread-Milling Attachment for Lathes, "Beckett"
C. H. Tracy Co., 161 Summer St., Boston, Mass.
"American Machinist," Oct. 3, 1918



Intended to cut either right- or left-hand lead screws with any of the various types of threads and also to thread work such as hobs, taps, etc. It may also be used to relieve taps at the same time as cutting if the lathe is provided with a relieving attachment. The device is bolted to the cross-slide of the lathe in place of the toolpost, the center point of the milling cutter being on a line and at the same height as the lathe center regardless of whether the milling cutter is vertical, horizontal or at an angle. The drive is by means of an electric motor. By disconnecting the worm and substituting small speed pulleys the attachment can be used with a grinding wheel in place of the milling cutter.

Lead-Screw Tester, "Lea"
C. H. Tracy Co., 161 Summer St., Boston, Mass.



"American Machinist," Oct. 3, 1918

For use on lead screws of any pitch or length up to 3 in. in diameter, but may be adapted for use on screws of greater diameter by means of special attachments. The sliding carriage moves on two steel bars and has a floating carriage mounted on ball bearings. The secondary, or floating, carriage is provided with a finger which engages the thread groove, and when this is engaged the position of the floating carriage in relation to the main carriage is determined by means of a micrometer, the position of the main carriage being determined by means of stops and any necessary precision-gage blocks.

Patented, Aug. 20, 1918

(Continued from page 736a)

body so as to obtain expressions that will represent the thought of the organized industries of America on the program to be adopted.

The various phases of foreign trade will be canvased in advance of the convention by committees which will call into consultation experts in order that concrete recommendations may be presented at the convention for discussion and adoption.

The following are the committees which have been appointed: Financing foreign operations, Lewis Pierson, Irving National Bank, chairman; shipping problems, C. Andrade, Jr., Mattack Coal and Iron Corporation, chairman; sales organization abroad, John McClain, Remington Typewriter Co., chairman; trademarks, C. W. Beaver, Yale & Towne Manufacturing Co., chairman; education for foreign service, W. W. Nichols, Allis-Chalmers Manufacturing Co., chairman; trade treaties, Fred B. Whitney, Deselektro Co. chairman, and a committee on foreign advertising

Personals

J. R. Miller has been appointed shop superintendent of the Williams Gauge Co., Pittsburgh, Penn., succeeding F. E. Cox.

James D. Robertson, sales manager of the Pittsburgh Valve, Foundry and Construction Co., has been elected a director of the company.

W. J. Priestly has resigned as division superintendent of the forges, foundries and machine shops of the Bethlehem Steel Co., Bethlehem, Penn.

Horace N. Trumbull, advertising manager of the SKF Ball Bearing Co., Hartford, Conn., has entered the Reserve Officers Training Camp at New Haven, Conn.

Joseph L. Ballash has resigned from the Torbensen Axle Co., Cleveland, Ohio, where he was assistant superintendent, and is now factory manager of the Advance Manufacturing and Tool Co. of the same city.

W. T. James, who has been connected with the Washington Steel and Ordnance Co. in its metallurgical department for over two years, has taken a position in the tool steel department of the Edgar T. Ward's Sons Co., Boston, Mass.

Ralph W. Clark of the New York office of Rogers, Brown & Co., has obtained a leave of absence and is now manager of the newly created Raw Material Section of the Production Division of the Ordnance Department, Bridgeport, Conn.

Frank H. Brown, one of the founders of of the Brown & Zortman Machinery Co., Pittsburgh, Penn., and more recently with the Davis Machine Tool Co., Rochester, N. Y., is now sales manager for the Sherritt & Stoer Co., Inc., Philadelphia, Penn.

Joseph A. Bower, vice president of the Liberty National Bank, New York, and **Henry J. Fuller,** vice president of the Fairbanks-Morse Co., New York, have been elected directors of the Standard Aircraft Corporation and Standard Aero Corporation, Plainfield, N. J.

Thomas J. Little, Jr., engineer of the Lincoln Motor Co., Detroit, has been appointed a member of the Welding Research Committee of the Emergency Fleet Corporation, United States Shipping Board. Mr. Little has been investigating gas and electric welding in all of the American plants producing Liberty motors.

William B. Stout, former aircraft engineer of the Packard Motor Car Co., Detroit, previous to that vice president in charge of engineering of the Scripps-Booth Corporation and until recently technical advisor to the Aircraft Board at Washington, has returned to Detroit, where he is making plans for the manufacture of an airplane he has designed. Mr. Stout recently resigned from the Aircraft Board.

Robert C. Byler, for four years advertising production man of the SKF Ball Bearing Co., Hartford, Conn., has been appointed advertising manager of the SKF Administrative Co., New York, and will direct the advertising of the SKF Ball Bearing Co. of Hartford, the Hess-Bright Manufacturing Co. of Philadelphia and the Atlas Ball Co. of the same city, all of which are controlled by the SKF Administrative Co. Until arrangements are made in New York Mr. Byler will remain with the SKF Ball Bearing Co., Hartford, Conn.

Trade Catalogs

Factory Buildings. The Austin Co., Cleveland, Ohio. Catalog. Pp. 64; 11 x 8 in. It gives a number of halftone illustrations of interiors and exteriors of various styles of factory building; also detail drawings of all cross-sections, floor plans, side and front elevations, together with specifications. It also gives a long list of owners of Austin-built buildings.

Chain Drives. Morse Chain Co., Ithaca, N. Y. Booklet. Pp. 24; 6 x 9 in. It gives information relative to the driving of camshafts, magnetos, lighting-system generators, pumps, etc., on automobiles. The booklet is profusely illustrated with automobile engines, cars, data tables and charts. It should be of interest to all manufacturers of engines, trucks and tractors and will be sent free to all making request.

Business Items

One of those ridiculous errors which will occasional creep in despite four proof-readers appeared in the Sept. 12 and Sept. 26 advertisements of the Fulflo Pump Co., Blanchester, Ohio. The ads should of course have read "Grit *cannot* shorten the life of the Fulflo."

Obituary

Just as we go to press word reaches us that SHERMAN C. SCHAUER, vice president and general manager of the Cincinnati-Bickford Tool Co., Cincinnati, Ohio, died Oct. 11. We will publish his obituary in our next issue.

Charles Gustavus Roebling, president of John A. Roebling's Sons' Co., died on Oct. 5 at his home, 333 West State St., Trenton, N. J., after a long illness from Bright's disease. He was 69 years old. Mr. Roebling was a graduate of the Rensselaer Polytechnic Institute, Troy, N. Y., class of 1871. After his graduation he became actively identified with the original John A. Roebling Co. as mechanical engineer. Mr. Roebling was a member of the Iron and Steel Institute of Mining Engineers, the Engineers' Club of New York and the Lotus Club of Trenton. Besides his business connections with the Roebling company, he was president of the New Jersey Wirecloth Co., vice president of the John A. Roebling's Son's Co. of New York and a director of the Mercer Automobile Company.

New Publications

Modern Management Applied to Construction—By Daniel J. Hauer. One hundred and ninety-four 6 x 9-in. pages; several diagrams. Published by the McGraw-Hill Book Co., 239 West 39th St., New York. Price $2.50.

The author says in his preface: "The principles of modern management should leave nothing for chance to decide. Therefore, the successful contractor of today must break away from the old inefficient methods and practice modern ways. To do this calls for real leadership. In mechanical lines much has been done to try out this new leadership—to adopt scientific management and establish new standards for greater efficiency in manufacturing. It has been thought that these principles, so successfully applied in the manufacturing field, are not applicable to engineering and architectural construction. This idea has, however, been proved erroneous by the successful work of those pioneers in the contracting field. The author's experience as a construction economist covering the past decade has taught him that scientific management is applicable to construction—he has applied and is applying the principles of such management with a fair degree of success." The various chapters are: What is Scientific Management; Old Versus New Management; Principles of Modern Management; Finances and Efficiency, Fundamentals in Choosing Type and Amount of Plant; The Application of Motion and Time Studies; Application of Modern Management; Cost Keeping and Bookkeeping; Systematizing Construction; The Effect of Modern Management Upon Workmen. In the appendix, under the title of The Organization of War Construction Forces, the author gives some up-to-date advice and graphically outlines organization arrangements on some of the Government cantonment and other work.

Forthcoming Meetings

The American Society of Mechanical Engineers will hold a meeting of its Midwestern sections, including Cincinnati, St. Louis, Chicago, Milwaukee, Detroit, Birmingham and Indianapolis, in the last mentioned city on Oct. 25 and 26. It is expected that the Indiana Engineering Society and the Indianapolis Lafayette section of the American Institute of Electrical Engineers will join in making the arrangements.

The American Society of Mechanical Engineers will hold its annual meeting in New York, Dec. 3-6. The secretary is Colvin W. Rice, 29 West 39th St., New York.

American Society of Mechanical Engineers. Monthly meeting second Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

The American Supply and Machinery Manufacturers' Association will hold a convention at the Traymore Hotel, Atlantic City, N. J., Oct. 22. The secretary of the association is F. D. Mitchell, 410 Woolworth Building, New York.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building Pittsburgh, Penn.

The National Implement and Vehicle Association will hold its twenty-fifth annual convention in Chicago, Ill., Oct. 16, 17, 18. Headquarters will be at the Congress Hotel. It will be distinctly a war convention.

The National Machine Tool Builders Association will hold its fall convention at the Hotel Astor, New York, Nov. 7-8.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 4, North Philadelphia, Penn.

Providence Engineering Society monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 240 Broadway, New York City.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Wasnington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15. Effective Apr. 1, the price of basic iron was fixed at $32, and standard Bessemer at $35.20 at Valley furnace, prices of other irons remaining the same as last quarter.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Current	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$33.00	$33.00	.....
No. 2X, furnace, New York	34.00	34.00	.....
No. 2, Chicago	.....	.....	33.00
Bessemer, Pittsburgh	36.60	36.60	36.30
*Basic, Valley, furnace	32.00	32.00	33.00
No. 2X, furnace, Philadelphia	34.40	34.40	33.75
*No. 2, Valley, furnace	33.00	33.00	33.00
No. 2, Southern Cincinnati	36.60	36.60	.....
Basic, Eastern Pennsylvania	32.90	32.90	45.00

*Delivered Pittsburgh $1.40 more.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.245	$4.245	$5.25	$4.17	$5.00	$4.27	$5.00
Soft steel bars	4.145	4.145	5.00	4.07	4.50	4.17	4.50
Soft steel bar shapes	4.145	4.145	5.00	4.17	4.50	4.17	4.50
Soft steel bands	4.745	4.995	.....	.....	.....	.....	.....
Plates, ¼ to 1 in. thick	4.495	4.495	10.00	4.42	7.00	4.25	9.00

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$3.50	$4.75
Warehouse, New York	4.75	4.75
Warehouse, Cleveland	4.67	4.95
Warehouse, Chicago	4.10	4.50

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
*No. 28 black	5.00	6.495	6.495	9.50	6.42	8.50	6.52	9.25
*No. 26 black	4.90	6.395	6.395	9.40	6.32	8.40	6.42	9.15
*Nos. 22 and 24 black	4.85	6.345	6.345	9.35	6.27	8.35	6.37	9.10
Nos. 18 and 20 black	4.80	6.295	6.295	9.30	6.22	8.30	6.32	9.05
No. 16 blue annealed	4.45	5.695	5.695	10.20	5.62	8.70	5.72	9.70
No. 14 blue annealed	4.35	5.595	5.595	10.10	5.52	8.60	5.62	9.60
No. 10 blue annealed	4.25	5.495	5.495	10.00	5.42	8.50	5.52	9.50
*No. 28 galvanized	6.25	7.745	7.745	11.00	7.67	10.00	7.77	10.50
*No. 26 galvanized	5.95	7.445	7.445	10.70	7.37	9.70	7.32	10.20
No. 24 galvanized	5.80	7.295	7.295	10.55	7.22	9.55	7.47	10.05

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 35c. for 19 to 24 gage; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 12%	List plus 25%
Cleveland	List plus 11%	List
Chicago	List plus 13%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$15.50–19	$14.00
Cleveland	20.00	15.00
Chicago	19.00	13.50

In coils an advance of 50c. usually is charged.

Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

⅝, ½, ⅜, ¼, 5/16 and No. 6, No. 8 and No. 10	22.10 to 33.00
No. 12, No. 14 and No. 16, No. 18 and No. 20	22.10 to 33.00

Cast-Iron Welding Rods

¼ by 12 in. long	16.00
¼ by 19 in. long	14.00
⅜ by 19 in. long	12.00
½ by 21 in. long	12.00

Special Welding Wire

⅛	33.00
3/16	30.00
¼	38.00

* Very scarce.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Tire	4.14	4.07	4.17
Toe calk	5.75	4.65	4.32
Openhearth spring steel (heavy)	8.00	8.00	7.50
Spring steel (light)	11.00	11.25	11.75
Coppered bessemer rods	9.00	8.00	7.07
Hoop steel	4.745	4.75	4.77
Cold-rolled strip steel	8.50	8.25	8.57
Floor Plates	6.245	6.00	6.25

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
⅛, ¼ and ⅜	44%	17½%	⅜ to 1½	33%	17%
½	48%	33½%			
⅝ to 3	51%	37½%			

LAP WELD

2	44%	31½%	2	26%	12%
2½ to 6	47%	34½%	2½ to 4	28%	15%
			4½ to 6	28%	15%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜	40%	22½%	⅜ to 1½	33%	18%
½	45%	32½%			
⅝ to 1½	49%	36½%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	42%	30½%	2	27%	14%
2½ to 4	45%	33½%	2½ to 4	29%	17%
4½ to 6	44%	32½%	4½ to 6	28%	16%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
⅜ to 3 in. steel butt welded	33%	16%	41%	26%	41.1%	26.1%
3½ to 3 in. steel lap welded	15%	+3%	37%	23%	37.1%	23.1%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 10 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	26.00*	26.00	23.50
Tin in 5-ton lots	78.50	83.00	62.00
Lead	8.05	8.05	8.50
Spelter	9.75	9.50	8.50

*Government price.

ST. LOUIS

Lead	7.75	7.75	8.00
Spelter	9.50	9.25	8.25

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Copper sheets, base	38.00	38.00	35.00	38.00	33.00	38.00	34.00
Copper wire (carload lots)	35.00	35.00	38.50	35.00	33.00	38.00	33.50
Brass sheets	39.75	39.75	40.00	40.50	33.25	38.00	35.00
Brass pipe	46.00	46.00	43.00	42.50	41.00	44.00	42.00
Solder (half and half) (case lots)	58.00	58.00	39.25	50.50	37.00	65.00	39.00

Note:—Solder very scarce.

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$37.75	$29.00
New York	34.25	35.00
Cleveland	38.50	34.00
Chicago	29.50	37.00

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 15.00

	In Casks Current	In Casks One Year Ago	Broken Lots Current	Broken Lots One Year Ago
Cleveland	18.75	20.00	18.40	20.50
New York	17.00	21.00	17.50	21.25
Chicago	22.00	21.00	21.50	21.50

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Current	One Year Ago
New York	14.00	15.00
Chicago	15.00	16.25
Cleveland	17.125	16.00

SHOP MATERIALS AND SUPPLIES

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York Current 1918	New York One Yr. Ago	Cleveland Current 1918	Cleveland One Yr. Ago	Chicago
Copper, heavy and crucible	24.00	24.00	24.00	24.75	23.50
Coppepr, heavy and wire	22.50	23.00	23.50	24.00	23.50
Copper, light and bottoms	20.50	21.00	21.50	22.00	21.75
Lead, heavy	7.25	8.00	.....	8.00	7.50
Lead, tea	5.50	6.75	7.50	6.00	6.50
Brass, heavy	14.75	15.25	16.50	17.00	23.50
Brass, light	11.00	11.50	12.50	13.00	12.85
No. 1 yellow brass turnings	13.75	16.25	14.00	16.00	14.00
Zinc	6.50	6.00	6.00	6.00	6.50

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, guaranteed over 99% pure, in ingots for remelting (1-15 ton lots), per lb.	33.20c.	32.20c.	33½c.

This is the Government price for lots of from 1 to 14 tons.

COPPER BARS from warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York	32.00	41.00
Chicago	38.00	41.00
Cleveland	36.50	39.00

BABBITT METAL—Warehouse price per pound:

	New York Current	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Best grade	95.00	70.00	93.00	69.75	96.00	70.00
Commercial	50.00	40.00	23.00	24.50	25.00	25.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York Current	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
* List plus.						
Hot pressed square	$2.50*	List	$1.25	$1.65	$0.98	$2.00
Hot pressed hexagon	2.50*	List	1.05	1.50	.78	2.00
Cold punched hexagon	2.50*	List	.75	1.25	1.00	1.50
Cold punched square	2.50*	List	.75	1.25	1.00	1.50

Semifinished nuts sell at the following discounts from list price:

	Current	One Year Ago
New York	40%	50%
Chicago	50%	50%
Cleveland	50 + 10%	50%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
% by 4 in. and smaller	30%	40+10%	37%
Larger and longer up to 1 in. by 30 in.	15%	20+ 5%	25—5%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:
New York ..... $2.50 Cleveland ..... $1.00 Chicago $2.50

For cast-iron washers the base price per 100 lb. is as follows:
New York ..... $5.00 Cleveland ..... $4.00 Chicago $4.50

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
% by 4 in. and smaller	30%	45%	32½%
Larger and longer up to 1 in. by 30 in.	15%	20+5%	20%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets Current	Rivets One Year Ago	Burs Current	Burs One Year Ago
Cleveland	List plus 10%	List plus 10%	List plus 10%	List plus 10%
Chicago	List price	List price	List plus 20%	List price
New York	20% from list	List plus 10%	List plus 20%	10-2½% from list

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ½ and smaller	30%	45—5%	40%
Tinned	30%	45—5%	40%

Button heads, ¼, ⅜, 1 in diameter by 2 in. to 5 in. sell as follows per 100 lb.

New York..$5.65 Cleveland..$5.15 Chicago..$5.67 Pittsburgh..$4.65

Coneheads, same sizes:

New York..$5.75 Cleveland..$5.25 Chicago..$5.77 Pittsburgh..$4.75

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	51.00	38.00	39.50
Brass	42.00	40.00	44.00

For immediate stock shipment 3c. is usually added. The prices of course vary with the quantity purchased. For lots of less than 100 lb. but not less than 75 lb., the advance is 1c.; for lots of less than 75 lb. but not less than 50 lb., the advance is 2½c. over base (100-lb. lots); for less than 50 lb. but not less than 25 lb., 5c. should be added to the base price; and for quantities under 25 lb. the increase above base is 10c.

TIN PLATES—Warehouse prices per box:

Coke tin plate, 14 x 20:

	Cleveland Current	Cleveland One Yr. Ago	Chicago Current	Chicago One Yr. Ago
100 lb.	$9.17½	$12.00	$10.60	$11.75
I. C. 107 lb.	9.42½	12.17½	10.70	11.90

Terne plate, 20 x 28:

Base Weight	Net Weight	Coating				
100 lb.	200	3	18.95	18.95	19.10	17.90
I. C.	214	8	19.25	19.25	19.40	18.25
I. C.	270	8	21.75	21.75	21.40	20.35
I. C.	218	12	21.75	21.75	22.60	19.25
I. C.	221	15	22.50	22.50	22.10	19.50
I. C.	226	30	23.25	23.25	22.60	20.50
I. C.	231	25	24.50	24.50	23.10	21.30
I. C.	236	30	25.75	25.75	23.60	22.25
I. C.	241	35	26.75	26.75	25.10	23.25
I. C.	246	40	28.00	28.00	25.60	24.55

NOTE—New York prices furnished on application to dealers. Price varies according to whether the plates are wanted for work essential to the war or for nonessential work.

COTTON WASTE—The following prices are in cents per pound:

	New York Current	New York One Year Ago	Cleveland	Chicago
White	11.00 to 13.00	13.00	16.50	12.00 to 16.50
Colored mixed	8.50 to 12.00	12.00	13.00	11.50 to 14.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13¼ x 12¾	13¼ x 20½
Cleveland	52.00	68.00
Chicago	48.06	50.00

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$1.75	$1.75	$1.75
Philadelphia	1.75	1.75	1.75
Cleveland	2.40	2.40	2.10
Chicago	2.00	2.00	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$4.30	$4.30	$4.30
Cleveland	4.60	4.60	4.50
Chicago	4.00	4.00	3.80

COKE—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	Oct. 10	Oct. 3	Sept. 26	Sept. 19	Sept. 12
Prompt furnace	$6.00	$6.00	$6.00	$6.00	$6.00
Prompt foundry	$7.00	$7.00	$7.00	$7.00	$7.00

FIRE CLAY—The following prices prevail:

		Current
Chicago	450-lb. bbl.	$2.50
Cleveland	375-lb. bag	2.50

LINSEED OIL—These prices are per gallon:

	New York Current	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Yr. Ago
Raw in barrels	$1.90	$1.23	$2.05	$1.30	$1.96	$1.27
5-gal. cans	2.00	1.33	2.20	1.40	2.16	1.37

WHITE AND RED LEAD in 500-lb. lots sells as follows in cents per pound:

	Red Current Dry	Red Current In Oil	Red 1 Year Ago Dry	Red 1 Year Ago In Oil	White Current Dry and In Oil	White 1 Year Ago Dry and In Oil
100-lb. keg	14.00	14.50	12.25	12.50	14.00	12.50
25 and 50-lb. kegs	14.25	14.75	12.50	12.75	14.25	12.25
12½-lb. keg	14.50	15.00	12.75	13.00	14.50	12.50
5-lb. cans	——	——	14.25	14.00	16.00	14.50
1-lb. cans	——	——	14.25	14.50	17.00	14.50

NEW *and* ENLARGED SHOPS

Consult the Buying Section when in need of machinery or supplies

WASHINGTON, D. C.

The Navy aims to give information regarding its purchases to all manufacturers known to be in a position to supply its demand. Owing to the need of prompt action in the cases of all machine tools hereinafter listed, the Navy cannot arrange to permit a postponement of the opening of bids if the manufacturers are able to secure bidding forms and submit their bids prior to date fixed for opening.

In case time does not permit this, it will be appreciated if any manufacturer not receiving information directly regarding these purchases will notify the Purchasing Division, Bureau of Supplies & Accounts, Navy Department, Washington, D. C., in order that the firm's name may be properly listed for all future purchases.

The Bureau of Supplies and Accounts, Navy Department, will receive bids furnishing the following metals:

Schedule No. 1959, ferrochromium, delivery South Charleston, W. Va.

Schedule No. 1960, chrome nickel, chrome, vanadium, grade C. V. steel, delivery Washington, D. C.; hot rolled or forged nickel steel, delivery various yards; shafting steel, delivery Newport, R. I.; spring, blue finished annealed steel, delivery Washington, D. C.

Schedule No. 1961, Class AN, square, semi-finished steel, class An, heat treated steel, class H.G. semi-finished steel; class H.G. heat treated steel, delivery various yards; hull, nickel plate steel, delivery Brooklyn, N. Y.; nickel steel, delivery Pensacola, Fla.

Schedule No. 1962, spring bar sheet rolled steel, delivery various yards.

The Bureau of Supplies and Accounts, Navy Department, soon receives bids furnishing machines and machine tools as follows:

Schedule No. 5781½, 2 engine lathes, delivery Newport, R. I.

Schedule No. 5877½, grinders, pipe machines, drills, etc., delivery Chelsea, Mass.

Schedule No. 5987½, machine tools, including emery grinders, etc.

Schedule No. 6084½, woodworkers' lathe, delivery Brooklyn, N. Y.

Schedule No. 6086½ 1 plate and shape spacing table.

Schedule No. 6110½, end mills and cutters, delivery Washington, D. C.

Schedule No. 6116½, two 15 ton turning riggings for handling heavy forgings.

Schedule No. 6117½, dies and punches.

Schedule No. 6120½, 1 slotting machine, 1 oil press transformer and 1 testing transformer.

Schedule No. 6165½, pipe threading and cutting machines, delivery Charleston, S. C.

Schedule No 6169½, 7 planers and jointers.

Schedule No. 6175½, hand tools, including punches, saws, pipe tongs and wedges, delivery Norfolk, Va.

Schedule No. 6176½, woodworkers' lathes, delivery Brooklyn, N. Y.

Schedule No. 6198½, 1 condenser, delivery f.o.b. works.

Schedule No. 6199½, rope testing machine, delivery Boston, Mass., and Mare Island (Vallejo, P. O.), Calif.

Schedule No. 6203½, 250 sounding machines, delivery South Brooklyn, N. Y.

Schedule No. 6206½, 1 drill, delivery Charleston, S. C.

Schedule No. 6234½, mills and cutters, delivery f.o.b. works.

Schedule No. 6236½, double end wire machines, delivery Washington, D. C.

Schedule No. 6238½, 1 molding machine delivery Washington, D. C.

Schedule No. 6239½, 1 molding machine, delivery Washington, D. C.

Schedule No. 6248½, 2 planers, 2 shafts and 2 bearings, delivery Charleston, S. C.

Schedule No. 6254½, 1 core-making machine and 1 core-cutting machine.

Schedule No. 6268½, machine tools, delivery Brooklyn, N. Y.

Schedule No. 6163½, punch and shear, delivery Puget Sound (Bremerton P. O.) Wash.

Schedule No. 6353½, 30 portable grinders, Puget Sound (Bremerton P. O.), Wash.

Schedule No. 6212½, key seating machine, delivery Brooklyn, N. Y.

Schedule No. 6216½, arbor presses, delivery Washington, D. C.

Schedule No. 6218½, emery grinders, delivery Washington, D. C.

Schedule No. 6244½, surface grinders, delivery Washington, D. C.

Schedule No. 5935½, miscellaneous machine tools, delivery Portsmouth, Va.

Schedule No. 6162½, universal shaping machine, delivery South Charleston, W. Va.

Schedule No. 6170½, trimming press, delivery Brooklyn, N. Y.

Schedule No. 6245½, machine tools, delivery Brooklyn, N. Y.

Schedule No. 6292½, pneumatic drills, delivery Boston, Mass.

Schedule No. 6293½, electrically driven emery grinder, delivery Washington, D. C.

Schedule No. 6297½, oil bearing and testing machine, delivery Annapolis, Md.

Schedule No. 6397½, machine tools, stay bolts, taps and dies, delivery San Francisco, Calif.

Schedule No. 6455½, cloth cutting machine, delivery Puget Sound (Bremerton P. O.) Wash.

Schedule No. 6497½, 4 traveling cranes, delivery Wash., D. C.

Schedule No. 6505½, 3 bench lathes, delivery Norfolk, Va.

Schedule No. 6507½, 1 pipe bending machine, delivery Norfolk, Va.

Schedule No. 6522½, 41 heavy engine lathes, delivery Norfolk, Va.

Schedule No. 6528½, 1 drilling machine, delivery Philadelphia, Penn.

Schedule No. 6529½, 2 disc grinding machines, delivery Norfolk, Va.

Schedule No. 6532½, lathe engine, delivery Newport, R. I.

Schedule No. 6561½, miscellaneous machines and furnishing forged cyclinders, f.o.b.

Schedule No. 6563½, miscellaneous furnaces, tools holders, guages, dies, grinders, drills, saws, end mills, cutters, etc.

Schedule No. 6572½, 1 caulking machine, delivery Philadelphia, Penn.

Schedule No. 6521½, 8 pipe and thread cutting machines, delivery Brooklyn, N. Y.

Schedule No. 6519½, 1 milling machine, delivery Philadelphia, Penn.

Schedule No. 6589½, 2 charging machines, delivery South Charleston, W. Va.

Schedule No. 6594½, 11 dowel and rod machine delivery Wash., D. C.

Schedule No. 6602½, 6 milling and 1 slotter machines, delivery Wash., D. C.

Schedule No. 6608½, miscellaneous lunching gears, f.o.b.

Schedule No. 6609½, 1 variety wood machine, delivery Lens, Del.

The Bureau Supplies and Accounts, Navy Department, will receive bids for machines and machine tools as follows:

Oct. 21—Schedule No. 6339½, 1 screw machine, delivery Newport, R. I.

Schedule No. 6388½, miscellaneous machine tools, delivery Puget Sound (Bremerton P. O.) Wash.

Schedule No. 6389½, 2 scraping machines, delivery Norfolk, Va., and Puget Sound (Bremerton P. O.,) Wash.

Schedule No. 6390½, 2 sensitive drills, delivery Charleston, S. C.

Schedule No. 6393½, 1 sheet metal cutter, delivery Puget Sound (Bremerton P. O.) Wash.

Schedule No. 6394½, 1 drill grinder, delivery Key West, Fla.

Schedule No. 6398½, 2 grinding machines, delivery Alexandria, Va.

Schedule No. 6399½, 1 screw slotter, delivery Philadelphia, Penn.

Oct. 22—Schedule No. 6421½, miscellaneous high speed drills, delivery Newport, R. I.

Schedule No. 6429½, miscellaneous holders, tool lathes, f.o.b.

Schedule No. 6499½, swing drill, delivery Paris Island, S. C.

Schedule No. 6500½, toolroom grinders and lathes, delivery Hingham, Mass.

Schedule No. 6506½, 300 drill extensions, delivery Boston, Mass.

Oct. 25—Schedule No. 6510½, 1 vertical boring milling machine, delivery Puget Sound (Bremerton P. O.) Wash.

Schedule No. 6511½, 2 belt driven planers.

The Bureau of Supplies and Accounts, Navy Department, received low bids furnishing machines and machine tools as follows:

Schedule No. 5692½, Class 665, planing machine, delivery South Charleston, W. Va., from Bethlehem Steel Co., Bethlehem, Penn., $301,000, alternate $160,000; Niles Bement Pond, 111 Broadway, New York City, $150,165.

Schedule No. 5850½, Class 759, reversible planer; Class 760, bench drills; Class 761, threading machines; Class 762, turret lathe, delivery, Puget Sound (Bremerton P. O.), Wash., from Bethlehem Steel Co., Bethlehem, Penn., (759) $29,100; Kemp Machinery Co., 223 North Calvert St., Baltimore, Md., (759) $21,203; (760) $247; J. Clark, Jr., 520 West Main St., Louisville, Ky., (760) $188; Sherritt & Stoer, Finance Bldg., Philadelphia, Penn., (760) $345; Greenfield Tap and Die Co., Greenfield, Mass., (761) $242; Geometric Tool Co., Blake and Valley St., New Haven, Conn., (761) $286; Landis Machine Co., Waynesboro, Penn., (761) $690; National Acme Co., 7500 Stanton Ave., Cleveland, Ohio, (761) $705; (762) $4572, alternate $4250.

Schedule No. 6103½, Class 1155, twist drills, delivery, Philadelphia, Penn., from Buckeye Twist Drill Co., Alliance, Ohio, $10,793; Chandler & Farquhar Co., 36 Federal St., Boston, Mass., $12,013; Cleveland Twist Drill Co., Lakeside Ave., Cleveland, Ohio, $10,827, part bid; W. E. Duff, 217 North George St., York, Penn., $9878; Lincoln Twist Drill Co., Taunton, Mass., $11,540; Morse Twist Drill Co., 170 Pleasant St., New Bedford, Mass., $10,889; National Twist Drill Tool Co., 1456 Brush St., Detroit, Mich., $10,717; Syracuse Twist Drill Co., 936 Grape St., Syracuse, N. Y., $12,018; Union Twist Drill Co., 70 Munroe St., Athol, Mass., $10,827; Whitman & Barnes Manufacturing Co., Buchtel Ave., Akron, Ohio, $10,803; Detroit Twist Drill Co., 634-66 West Fort St., Detroit, Mich., $10,803; New Process Twist Drill Co., 34 Court St., Taunton, Mass., $1477, part bid.

Schedule No. 6105½, Class 1157, hammers; Class 1158, pneumatic hammers, delivery Washington, D. C., from Cleveland Pneumatic Tool Co., 3734 East 78th St., Cleveland, Ohio, (1157) $360; Ingersoll-Rand Co., 11 Broadway, New York City, (1157) $297; (1158) $2624; Keller Pneumatic Tool Co., Grand Haven, Mich., (1157) $240; (1158) $2138; G. Oldman & Son Co., 4320 Tacawanna St., Philadelphia, Penn., (1157) $210; (1158) $1855.

Schedule No. 5987½, Class 1160, emery grinder, delivery Boston, Mass., from Challenge Machine Co., 5116 Springfield St., Philadelphia, Penn., $195; Kemp Machinery Co., 223 North Calvert St., Baltimore, Md., $119; Lynd-Farquhar Co., 36 Federal St., Boston, Mass., $194; D. Nast Machinery Co., Bourse Bldg., Philadelphia, Penn..